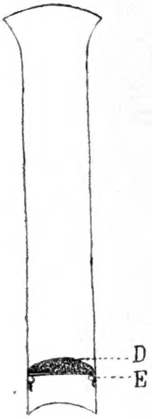

Fig. 2.

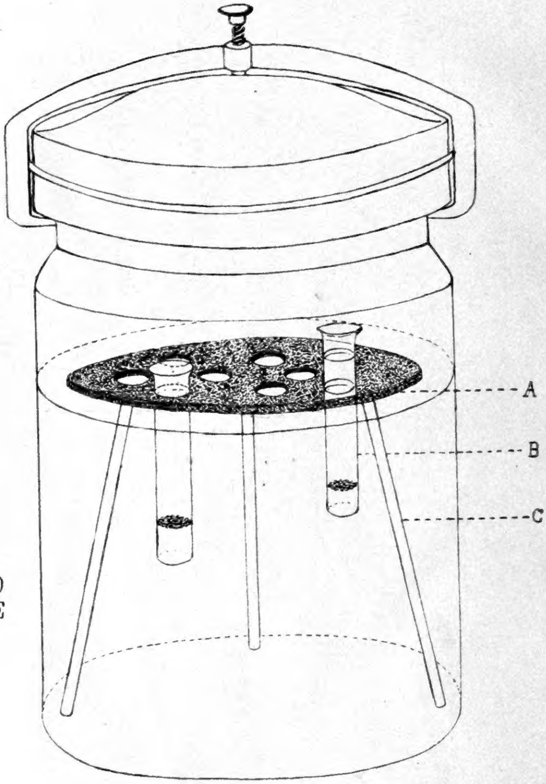

Fig. 1.

THOMAS'S DEHYDRATING APPARATUS.

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Diatoms: their Life-History and their Classification.

BY REV. FREDK. B. CARTER,
MONTCLAIR, N. J.

[*Continued from page 280, vol. xi.*]

Since the first part of this article was put in print, Wolle's fine work on the Diatomaceæ of North America has appeared. In Plate I, figs. 13, 14, 15 illustrate plainly the point for which I contend. No one can mistake those drawings. And yet even in this magnificent collection of twenty-three hundred figures, the student will find very few besides which indicate clearly the relation of the two valves to each other, not even in the Plate cix of *Isthmia*. Here, again, the lines of the inner and outer valves are drawn as forming one continuous line. This is the more to be regretted because *Isthmia* affords one of the most striking examples of the true relation of the valves. Out of the whole 2,300 figures, I can find only ten, exclusive of those just mentioned, which would lead the student to suspect the true relation, and they might readily be missed among so many. (See Plates lxv, 24; lxxviii, 1; xcv, 11; xcvii, 11; xcix, 1, 3; cii, 2; c, 7, 10, 14.)

In the same work there is a statement on the structure of the diatoms which strikes us as incorrect. Thus, p. x, we read: "In the pill-box-like siliceous structure of diatoms, the top and bottom constitute the *valves;* the sides are known as the *connecting membranes* or *sutural zones*, and when detached are termed *hoops*. In some the valves do not fold over, but merely rest against each other—edge on edge. The line of junction forms a suture, raphé, or median line, along which the valves readily separate. H. L. Smith divides diatoms into three groups, according to the presence or absence of this suture."

Here the suture is made identical with the raphé or median line; whereas, as I understand it, it is entirely distinct. The suture is seen in front view, and is the line of junction of the two valves; but the raphé or median line is seen in side view, and there is commonly *one*

on each valve. Nor do the valves separate along the raphé or median line, but along the line of junction or suture. If the reader will turn over a page or two to the conspectus, he will see it stated by H. L. Smith, of Tribe I, Raphidieæ, for example: "Frustules, mostly bacillar in s. v., always with a distinct raphé on *one or both valves.*" (Italics mine.) Thus the two statements do not agree, and that on p. x will be likely to give the student a very different idea of what is meant by the raphé.* But to return to our article.

The trouble has all come, in my opinion, from calling the inner portion of the valve a hoop at all. For it suggests at once a barrel-hoop, something which is free at both edges from that which it encloses; which is not usually the case with the diatom hoop, to say the least. It is a misleading term, and is bound to confuse the student. It would be much better, therefore, it seems to me, to drop it altogether, or to speak of this piece as that portion of the membrane of each valve which *when separated from the valve* has the shape of a hoop. For as long as it is attached to the valve it is *not* a hoop, but the continuation of the valve itself. Finding this portion, however, at times detached, and shaped like a hoop, observers have thought there was only one hoop to each frustule, and that it bound the two valves together, whereas the truth is that there is a so-called hoop to each valve, and the hoops found in settlings of the Diatomaceæ did not come each from a frustule but each from a valve, that is, two from each frustule. (There may be a few exceptions, but in my opinion the above will hold as a general statement.)

Now, I am inclined to believe that very few amateurs have had the occular demonstration of this fact. Having to write upon the subject, and finding it impossible to reconcile the figures with what Carpenter said, I went to my slides again, and with the binocular, and almost the first peep at *Isthmia* showed me that the drawings were faulty in representing the upper and lower edges of the two valves as continuous lines instead of broken ones. And then I took down Schmidt's plates and the whole thing was as clear as day. And my advice to the student is to do the same thing: to pick out all his slides of *Isthmia*, *Biddulphia*, and *Triceratium*, and using the binocular, look sharp at the upper and lower edges of the hoop, and he will soon see that each is not one continuous line, but is formed by two lines, one of which is inside the other. And then if he is fortunate he will find some frustules where the valves have partly separated, and he will find that each valve has its band or hoop, and that it forms *one continuous piece* with the valve. And when he has done this he will have done something that is better than resolving *Amphipleura*, for he will have gained a definite idea of the structure of the diatom frustule. And this is a point that cannot be too strongly insisted upon, since even the Micrographic Dictionary has gone through edition after edition without stating or figuring the matter correctly.

The first thing then for the student to do is to get a correct idea of the way the two valves are put together, and to do this he must not rely upon the figures in the Micrographic or in Carpenter, but study carefully the actual diatoms with the binocular. It will also be well

* Since the above was put in type, Wolle has issued errata making the correction.

to represent the diatom cell by the use of paper models or other objects. One of the best I know of is a cigar-case made of two halves, one of which slides over the other. It is a much better object for the purpose than the pill-box for such forms as *Isthmia* and *Biddulphia*. It is capital for these, and also, when viewed endwise, for the *Navicula* forms. But two paper cylinders with convex ends, one cylinder enclosing the other, are perhaps the best of all, as being the most pliable and as representing the typical form of the diatom, which is that of a cell. When the two valves are prolonged the diatom cell becomes a cylinder; when the cell is compressed it takes the oval or boat form, or the form of a triangle or square, as the case may be. Now, paint a stripe around the open end of each half of the paper cylinder, where one slips over the other, and you have the true representation of the hoop, and will never be puzzled again about its relation to the valve, and when you draw *Isthmia* in front view you will not draw the edges continuous but broken, showing that one valve is partly inside the other.

After you have thus made yourself thoroughly acquainted with the true shape of the diatom cell and the relation of its two valves, get hold of Wolle's Desmids and study the plates carefully. Compare the front and the end views of the same desmid and see how remarkably they differ, and you will understand still better the difference between the front and side views of the diatom, for the end view of the desmid corresponds to the side view of the diatom. And you will also note the close correspondence between the diatoms and desmids as a whole, and have a fresh proof of the vegetable nature of the diatoms and of the correctness of the place which has been assigned them in the vegetable world among the algæ and close to the desmids. Look at the filamentous forms of the desmids and see how much they resemble the filamentous forms of the diatoms. And then study the growth of the desmids by division, and you will be able to grasp the true idea of the growth of the diatoms by the same process, for there is the same dividing of the one cell into two by the formation of two new semi-cells between the halves of the mother-cell. See pl. xiv, figs. 12, 13, Wolle, of a *Cosmarium* so dividing and multiplying. See also pl. xxii, fig. 5, for *Xanthidium* in process of division. Also pl. xlv, figs. 19, 20, of *Staurastrum*. And note particularly that the new semi-cell is at first smaller than the semi-cell from which it grows. And the reason why it afterwards reaches the full size is because there is no prolongation of a silicified membrane enclosing and limiting it as in the case of the diatom. And *that* is one of the distinguishing features between the diatoms and the desmids. In the desmid the two halves or valves are joined edge to edge, are exactly alike. In the diatom on the contrary, or at least in most cases, the two halves or valves are joined like two joints of a telescope, so that one half is always just large enough to slide over the other half. And as the free, open end of each half of the diatom is silicified as well as the rest of the valve, the semi-cells formed within are necessarily smaller than their respective mother-cells or original semi-cells. But while one of the new frustules will be smaller than the frustule from which it is produced, the other will be, or may be, just as large. Your paper model will show this. For it is evident that another valve can be formed inside the larger of the two

original valves *just equal* to the smaller valve which the larger originally overlapped or enclosed. The result, therefore, of multiplication by division is not that *each of the succeeding pair* of frustules is smaller than the frustule from which it originates, but that only *one* of each pair is. And thus there will always be some frustules which represent the typical or original size of the diatom; just as many in fact as there are individuals of the species at the time the multiplication takes place. One of the new frustules, however, is smaller than the original frustule, and so it must be at each new division. So that we shall have, or ought to have, as many frustules of the original size as there were individuals of the species at the time of division, and any number of the next smaller size. For each original frustule holds its own as to size by simply restoring itself at each division, and it can produce as many frustules of the size next smaller as the vitality of the orignal frustule will allow. I mean, that the larger valve can keep reproducing valves of the size of the smaller valve and letting them go at each division. Thus let *a* represent the larger valve of a frustule and *b* the smaller valve. It is plain that *a* can always reproduce *b*, in other words produce a second *b*, and let the first *b* separate itself. And so the original frustule keeps restoring itself and at the same time sending off a valve of the size of *b*, which has formed within itself a smaller opposing valve, *c*, and become also a complete frustule, and *b* in turn can do the same. So that there will always be one representative in size of the original frustule for each of the individuals of a given species at the beginning of the process of division, and as many representatives in size of the frustule of which *b* is the larger half as there are divisions of the original frustule of which *a* is the larger half. For that frustule does not simply divide once and then stop, but keeps on dividing again and again after each reproduction of itself. That is to say, it is not as if *b* separated from *a* and then *b* alone produced *c*, and *c* in turn separated from *b* and *c* alone produced *d*. In short, it is not like the Japanese egg which encloses a smaller egg and so on *ad infinitum*.

I emphasize this point, because Carpenter says that "It seems to be in this way that the normal size is recovered, after the *progressive diminution* (the italics are my own) which is incident to repeated binary multiplication," * leading us to infer that one of the valves loses its vitality at each division, or at each after the first, for he also calls attention to the fact that "in those newly-formed frustules which have been just produced by binary subdivision * * * one of the valves is always older than the other." † But there is no apparent reason why one valve should have any more vitality than the other, for the two original valves form one and the same diatom cell to begin with, and each half produces another half within itself. Neither of the two resulting frustules therefore will have any more vitality than the other. In other words, for all I can see, one frustule can produce as many pairs of frustules as any other from the original down, and if so the size does not *progressively* diminish; there will always be as many frustules of the original size as there were at the start, and the number of the next size smaller will be equal to the number of times the original frustule divides.

* P. 337, 6th edit. † P. 328.

If a *whole frustule* were formed inside *each half* then the size would progressively diminish, but this is not the case, nor would it correspond to the growth of the desmids, which is very similar. How *long* the vitality of *both* of the original valves continues is of course an open question, but the two form one cell at the start, and the vitality of that cell is equally shared by both valves. In each new generation, then, by conjugation the two valves are of the same age. Furthermore, there is no apparent reason why the two older valves should not maintain their vitality for a considerable length of time, for the original semi-cells of the desmids do, for in a filamentous desmid the halves of the original cell are at the *extreme ends*, and those two halves have been concerned in the production of *all* the intermediate cells. At the start the two halves were united. They separated and each half formed a new half. Then there were two cells instead of one, each having one-half of the original cell. Each new cell divides again, that is to say, one of the original halves forms again another half for itself, and the newer half does the same, and the result is that the two original halves are at the *ends* of the filament, while the two halves which were formed *next* are at last in the *middle* of the filament. And how much vitality the two original halves have we may gather from the fact that Wolle figures a fragment of a series of adhering cells of *Micrasterias* (fig. 8, pl. xxxviii), which he says must originally have numbered no less than sixty-four. Nor is there any reason to suppose that even that is the limit for all cases. My point therefore is that the larger valve of the original frustule of the diatom can go on producing complementary valves again and again which will be as large as the other half it originally had, and so our frustule will keep the normal size for each individual of the species that is present at the time division begins. Probably the diatoms follow the same course as the desmids, multiplying by division, with diminished vitality in *both* the original valves until the latter part of the summer.

I may be wrong, and, if so, am open to correction, but the impression Carpenter's description makes upon me is that the process of conjugation is necessary to the recovery of the normal size, because of the progressive diminution which is incident to repeated binary multiplication *in plants so constructed as the diatoms.* For the above statement occurs shortly after he has said "multiplication by binary subdivision takes place among the diatomaceæ on the same general plan as in the desmidiceæ, but with some modifications incident to the peculiarities of the structure of the former group (p. 334). At any rate my contention is as to that idea, whether Carpenter implies it or not. I wish to say, therefore, that, in my opinion, the reason for conjugation is primarily for the recovery of vitality, and that while it also has to do with the recovery of the typical form in the case of the diatoms, there is nothing exceptional about it. For the same is true of the desmids, and even of the infusoria. In other words, multiplication by binary subdivision tends to decrease in size *any way*, in the long run, through loss of vitality, and not merely in the diatoms, because one valve is smaller than the other. Thus Wolle says of the desmids: "The frequent variations in outline of form in certain species is calculated to mislead, and, perhaps, suggest notions of variation of species, but close observation will soon dispel such notions, and prove that they are merely temporary results of

exhausted vitality in the process of multiplication by division. * * * An impoverished condition is * * * frequently the result of the process of multiplication" (pp. 18, 20). And in an article in the *Monist* for October, 1890, Binet quotes Balbiani (on the subject of fissiparous reproductions among Ciliate infusoria) as saying: "We have established that this mode of propagation has its limits, and ends invariably in one of the three following ways: either by the *natural* and almost simultaneous *death* of all the individuals belonging to the same cycle, or by the recurrence of sexual generation leading to the termination of one of the cycles and the commencement of a new cycle, or, finally, to the phenomenon of encystment, which, in fact, brings about only a momentary interruption of the process of reproduction by fissiparity." And Binet says: "Müller had observed that the individuals of any one species most ordinarily found in coition were almost all of small stature. Now these individuals of small size * * * are the ones that are the result of a great number of successive bipartitions; and it is to be observed that, in a great many species, in proportion as the bipartitions increase the size of the infusoria decreases. * * * In *Stylonichia pustulata* * * * and in all species the body is reduced, and becomes more and more shrunken, assuming forms and *contours very far removed from the specific* type. * * * When the vitality of the infusoria has become weakened by a considerable number of agamic reproductions, and the animalcule is upon the point of dying a natural death, a new biological phenomenon can intervene, rejuvenating the animal and rendering it capable of reproducing itself anew for a long series of generations. That phenomenon is fecundation."

The diatoms, then, follow other well-known examples in both the vegetable and the animal world, passing through cycles of generations by division and by conjugation. In other words, if the diatoms reproduce the specific type by means of conjugation so do the desmids and so do the infusoria. The necessity for conjugation therefore in the diatoms, as in the desmids and in the infusoria, arises primarily in my opinion from the loss of vitality due to repeated binary multiplication, which results in decrease of size of specific type, whether any such peculiarity exists as we find in the structure of the diatom or is utterly wanting. There would be *fewer* examples of the original size in the case of the diatoms if multiplication continued without the repeated intervention of conjugation. But there would always be some examples of the original size, just as many as there were individuals of the species to begin with at the time of multiplication by division, and still more of a size next smaller. Furthermore, I question whether the difference in size between the original frustule and that which is the result of the first division is any greater than is found between the individuals of the same species in repeated instances in the vegetable world without causing any comment.*

* J. D. Cox has called my attention to his paper on Isthmia. My statement was based on Carpenter's representation of Cox's position, viz: that "in Isthmia there are *three* hoops—two attached to the two valves, and the third overlapping them both at their line of juncture." But I find that Carpenter has misrepresented him. He does not assert that of all cases, only of a part.

[*To be continued.*]

A Dehydrating Apparatus.

By M. B. THOMAS,

BOTANICAL LAB., CORNELL UNIV., ITHACA, N. Y.

[See Frontispiece.]

A very convenient form of Schultze's dehydrating apparatus can be made as follows:

In a 9 x 9 inches Whitall-Tatum museum jar a disk of plaster of Paris is supported about 2 cm. from the top by means of legs made of glass rods (Fig. 1, A and C.) The disk is perforated to allow tubes of various sizes varying from 2 to 4 cm. in diameter to pass through. These are the so-called dehydrating tubes. (Fig. 1, B.) The plaster of Paris diaphragm can be made by first making a mould of the desired size with a paper bottom and a card-board hoop for the outside. This must be placed on a level surface. The plaster of Paris is then softened with water and poured into the mould to about the depth of 1½ cm. While it is yet soft the three legs can be inserted near the edge, and holes for the dehydrating tubes cut in the disk with a knife, or pressed out with glass tubing of convenient size. When the plaster of Paris is thoroughly dry the hoop can be removed and the disk placed in position in the jar.

The jar is then filled with alcohol to about 2 cm. of the under side of the disk. The dehydrating tubes should be about 12 cm. long, and can be made by cutting off the bottom of large test tubes. At the bottom is placed a diaphragm of chamois skin, which can be fastened in place by means of a spring made of steel wire, and forced inside of the chamois skin in the tube, thus pressing the former firmly against the latter (Fig. 2.) A rubber band around the tubes prevents them from falling through the holes in the disk, and enables them to be lowered to any desired depth in the alcohol.

The tissue to be dehydrated is packed closely in the dehydrating tube, and enough 50 per cent. alcohol poured over it to just cover it. It is then lowered through the hole in the disk until the two liquids are at a level. After from 12 to 24 hours the two liquids will be of the same strength. The tissue can then be taken out and placed in the infiltrating bath at once.

This method for hardening has been tried in the Bot. Lab. at Cornell University on nearly all kinds of plant tissue, and in every case it was found to be successful. For the most delicate tissue where slow hardening is desired, 5% alcohol can be placed in the dehydrating tube and thick chamois skin used for a diaphragm and for some of the more delicate algæ it has been found advisable to use as low as 1% alcohol in the tube. The strength of the alcohol in the jar can be kept up by adding to it from time to time some calcium chloride. This will not injure the alcohol in the least.

The jar should be tall enough to allow the cover to be kept on while the tubes are in position, and thus prevent evaporation of the alcohol. An apparatus of such a form having 13 dehydrating tubes has been in nearly constant use in the Bot. Dep. for a year without changing the alcohol, and is yet in good working order.

Experiments have been made with one of smaller size, and it is found that all hardening agents such as picric, chromic, acetic, or osmic acid can be used in it with equal success.

The advantages claimed for the apparatus are these: Not more than 24 hours is necessary for dehydrating and hardening nearly all kinds of plant tissue. The apparatus does away with the transferring of the tissue from bottles containing alcohol of different strength, and as no sudden transition from solutions of different strength occurs the tissue is less liable to shrink. The simplicity of the apparatus places it in the reach of all. Many different materials may be used for a diaphragm, and almost any desired speed of dehydrating obtained. The apparatus can also be made of any size to adapt it for private or general Lab. work.

It would seem that such an apparatus would work equally well for animal tissue, but as yet I have not been able to make an extended trial of it; however, in the case of some insects hardened in it, it was found to be admirably adapted to the purpose.

Microscopy for Amateurs.

By T. CHARTERS WHITE,

QUEKETT CLUB.

[*Continued from page 275, vol. xi.*]

Staining Tissues.—Staining has added a fresh power to the microscope, for without its aid the highest magnification would fail to show many interesting details. Staining may be general or selective; by the first, nothing is learned, but it is useful sometimes in showing up the structures which are too transparent to be seen otherwise, and is of great service, when the object is to be photographed, in presenting a contrast against the general field of view. By selective staining, which selects the growing parts of a tissue, the nuclei are brought into view, and the formed material is differentiated from that which is in process of formation.

Some histologists prefer to stain the hardened tissue before cutting, which is followed by very good results; but staining the section is just as easily done without requiring so long an immersion as staining it in the mass. The stains can be procured all ready prepared, but there are one or two which are made without any difficulty, and which the student can readily make for his own use; they are carmine, logwood, and picric acid. Dr. Beale's directions for making the carmine stain, are: "Carmine, 10 grains; strong liquor ammonia, ½ drachm; Price's glycerine, 2 ounces; distilled water, 2 ounces; alcohol, ½ ounce. The carmine in small fragments is to be placed in a test tube, and the ammonia added to it. By agitation, and with the aid of the heat of a spirit lamp, the carmine is soon dissolved. The ammoniacal solution is to be boiled for a few seconds, and then allowed to cool; after the lapse of an hour, much of the excess of ammonia will have escaped. The glycerine and water may then be added, and the whole passed through a filter or allowed to stand for some time, and the perfectly clear supernatant fluid poured off and kept for use. This solution will keep for months; but sometimes a little carmine will be deposited owing to the escape of ammonia, in which case one or two drops of liquor ammonia to the four ounces of carmine solution may be added."

Logwood stain may be made easily from any of the numerous formula. "Take logwood extract 6 parts, alum 6 parts, sulphate of cop-

per 1 part, water 40 parts. All ingredients must be free from iron. Grind the alum, logwood extract, and sulphate of copper in a mortar, and when powdered, add sufficient water to form a thin paste, leave for one or two days, with occasional stirring, and then filter." The stain made from a similar receipt was found to work very efficiently, and at the same time it can be easily made.

Picric acid, which has the property of staining yellow such structures as the epithelial surfaces, requires but solution in distilled water to fit it for use. Sometimes it is used in combination with carmine solution; but it is preferable to use them separately or conjointly as cases may require. The sections which have been cut may be placed in either of these as the student may choose, but he should bear in mind the advantage of using these stains diluted, and of slowly staining them. For this purpose watch-glasses or shallow glass dishes will be found of great use. The sections, being placed in the staining solution in one of these, may be covered up and left for a short interval, till the staining is considered deep enough, when it may be removed to clean distilled water, and examined, any stray fragments being removed with a camel's-hair brush kept for that purpose. If the section is sufficiently stained it may be transferred to a small quantity of absolute alcohol to dehydrate it. Having been steeped in this a short time, put a drop of oil of cloves on a glass slide, and taking up the section with a pair of forceps, drain it from the spirit, and when nearly dry place it on the top of the oil of cloves, which, thus taking the place of the spirit as it evaporates, will clear the section and render it transparent. If the section is left too long in the oil of cloves it becomes shrunken and distorted; therefore, as soon as it is quite evenly clear, it may be drained from the oil and mounted in balsam, preferably the balsam and benzole solution. This, then, is the *modus operandi* to be observed in all section mounting, subject to varying treatment when other mounting media are employed.

The beauty of some vegetable sections if double stained, and this does not entail much difficulty in its accomplishment, will be an addition to the student's pleasure if directions are here given. Judson's scarlet dye may be added to water till a good color is obtained, when the solution must be filtered through blotting-paper. Judson's blue dye may be dissolved in methylated alcohol, and the solution filtered. These solutions, well corked, keep for a considerable time. Prepare two watch-glasses and put a little of the red solution in one, in which place the section. When it becomes stained an uniform red, remove it to the other watch-glass, in which pour some of the blue. This will drive out the red stain from all but those definite portions of the section to which the red will cling with great tenacity; after which it may be treated according to the foregoing directions, and mounted permanently.

The subject of bacilli, and their occurrence in the sputa of phthisical patients, and their staining are of interest. The sputum is spread in a thin layer on a cover-glass, and dried at a temperature of 212°–230°, or passed three or four times through the flame of a spirit lamp. The staining fluid is prepared as follows: 5 c.c. pure aniline added to 100 c.c. of distilled water, well shaken and then filtered through moistened blotting-paper. To this mixture a saturated alcoholic solution of fuchsine, methyl violet, or gentian violet is added, till precipitation com-

mences. The cover-glass is allowed to float on this with the sputum downwards for from a quarter to a half an hour. It is then washed for a few seconds in nitric acid, one part, distilled water, two parts, and afterwards in distilled water alone. It may then be dried and mounted in balsam.

Chloride of gold is employed as a staining agent when it is desirable to bring out the exceedingly fine ramifications of nerve tissues, but care is required in its use to avoid overstaining. The solution should be very dilute, about one part of the gold salt to two hundred of distilled water. The section may be placed in this from a quarter to half an hour, and then removed, freely washed with a large quantity of distilled water, to which a sufficient quantity of acetic acid has been added, to render the water perceptibly acid, and placed in the light, which, acting on the gold, gradually darkens it to a pale violet color. If the gold solution has been too strong, or the immersion too prolonged, the section will become of such a dark purple as to be almost useless.

Diluted solution of osmic acid is useful for staining fat cells, but great care must be taken by the student to avoid the fumes, which are very injurious to the eyes and the mucous membranes of the nose and throat. The fumes themselves are sufficient to stain many delicate preparations, and even to kill small insects.

The stain or reagent which may be employed to identify starch cells is: Iodine, 1 gramme; iodide of potassium, 2 grammes; water, 100 c.c. A small quantity of this placed upon starch will turn it at once to a purple color, and proves its nature beyond doubt.

It is sometimes necessary in preparing vegetable sections to bleach them prior to their undergoing staining processes; for this purpose they may be placed in a solution of chlorinated soda. This removes all the green coloring matter harmlessly, and renders them, after copious washing, ready to take any stain.

Insect Anatomy.—The student may now have acquired that dexterity and steadiness of hand which will be required in the study of insect anatomy. No great difficulty will obtrude itself, but a draft will be made on his patience, for nothing can be accomplished without great care and an entire absence of hurry. It is more conducive to success if some of the larger insects are chosen to begin upon. The common kitchen cockroach will be convenient and interesting to commence on. Chloroform offers a safe and at the same time the least painful agent for killing insects. The one to be dissected should be placed on a piece of blotting-paper under a glass, with about thirty drops of chloroform. In a minute's time it will have been killed without suffering. Before proceeding to the dissection form a definite plan, and select the particular part to be investigated. The abdominal viscera present the least difficulty. In this, as in all cases, first remove with scissors such embarrassing organs as the legs, wings, and antennæ; the insect may then be securely fastened below water, to which a few drops of alcohol has been added, the alcohol slightly hardening the delicate viscera, while the water floats them, and keeps them from becoming entangled. There are two methods by which this very necessary security may be attained; that most generally recommended is by pinning the insect to a layer of entomological cork, attached to some sheet lead. A plan which has been adopted with great success is as follows: Cut a piece of gutta-

percha four and a half by two and a half inches, soften it in hot water, and bend up its edges into a dish. Drop on the bottom of this some of the wax and Canada balsam mixture, and while it is warm and soft stick the back of the insect into it; in this way we get rid of the pins which, under the old plan, were in the way. When the composition has set and the insect has been securely stuck down, the water and the spirit may be poured into the dish and the dissection commenced. This may be done under either a regular dissecting microscope, or by an ingenious arrangement which may be constructed in this manner: a stout wire of brass or iron should have one end fastened into a heavy square foot of lead, the other end of the wire must be bent into a ring, which will hold a watchmaker's eye-glass. The trough containing the insect should then be mounted on a block of wood to bring it within the focus of the glass. In carrying out the dissection the eye is placed in contact with the circular frame of the eye-glass, and by raising or lowering the head the focus is adjusted, the weight of the leaden foot keeping it in position, and allowing a movement up or down as the exigencies of the dissection demand. Some operators hold the glass in their orbit as the watchmakers do, but this involves much muscular fatigue. A low power objective, such as an inch and a half focus, may also be employed, but the constricted field of view does not compensate for the higher magnification. If the student can afford a binocular erecting microscope, this is the acme of perfection and convenience, and by its means and a steady hand the author has often dissected out the salivary glands of a flea. Having this or any similar arrangement, cut up the brown chitinous skin on each side of the abdomen with the scissors, taking care that their points do not penetrate so deep as to injure the internal organs. Then, with the forceps, raise the skin, beginning at the thoracic end, and as it is raised clear away the tracheal attachments by the aid of needles free from all traces of rust. It is here the gilded needles will be found so advantageous, for these delicate tracheæ cling with great tenacity to any roughness, and although at this stage of the proceedings it would not be of much consequence, at a later period such a catastrophe as the entanglement of the tracheal tubes in a rusty spot would be fatal to success, and spoil the work of hours.

If the brain and neural system are to be dissected, place the insect in the wax composition on its ventral surface, dissecting from the dorsum. Any organ which may be deemed worthy of preservation may be detached with scissors, and after staining may be mounted in diluted glycerine. It is advantageous to have a knowledge of the names and uses of the various organs, and a reference to Burmeister and Lowne may furnish information relative to some of these. It is one of the disadvantages of the present state of entomological science that information is scattered all through literature instead of being gathered under one compilation. This is in brief the method to be pursued in all insect dissections, enabling the student to compare the variations of the organs in different subjects; for instance, those peculiar glandular bodies found in various insects, the rectal papillæ. In the blow-fly they are four in number, of a pyramidal shape, projecting from the walls of the rectum, where they perform the functions usually carried on by the kidneys in the higher animals, of secreting uric acid. Well-formed crystals are frequently found in the pouch. The same organs

in the earwig are six in number, of a circular shape. In the flea they are six in number, but oval. In the bee they are eight in number and elongated. Many interesting points may be made out in the examination of newly-hatched insects: for instance, the wings of a butterfly are far more beautiful objects if the butterfly is removed from the chrysalis before it has had time to spread its wings. So in the blow-fly freshly hatched, many parts, such as the tongue, can be more easily mounted than after they get old and stiff. A freshly-hatched blow-fly may be fed on cochineal and sugar, when, on dissecting the alimentary canal, it will be found colored with the carmine for its whole track.

Many beautiful specimens may be made from small insects which have been steeped in the strongest carbolic acid solution, especially if they are mounted entire without compression. Calvert's crystalized carbolic acid, which is solid at ordinary temperatures, is the most suitable. If this is liquefied by heat, and about one drachm of glycerine added to two ounces of melted carbolic acid, it will prevent its becoming solid again. In this condition it is not only useful for rendering insects transparent, but can be used for cleaning all stained vegetable sections instead of oil of cloves. It may sometimes be necessary to bleach insects, especially if they are to be photographed through the microscope. Such a bleach may be made by placing some crystals of chlorate of potash in a wide-mouthed two-ounce bottle, and pouring on one ounce of water; if to this a few drops of hydrochloric acid be added, chlorine gas is slowly evolved, which, acting on the chitine of the insect's skin, after a week's immersion bleaches it as white as paper. Since it destroys all internal anatomy by its corrosive action, the student must be careful not to inhale the fumes from it, as bronchial mischief may easily ensue. Interesting specimens may be made from the corneæ of the larger insects, such as *Dytiscus marginalis*. They are more easily removed, and are tougher to manipulate. On cutting them off they will be found convexo-concave in shape, the concavity being filled with pigment, which must be carefully cleansed with a camel's-hair brush. They are difficult to mount on account of their convex form, but by judicious slitting in two or three places round the edge and by pressure they may be flattened sufficiently to show the lenticular structure. If properly prepared, each facet shows clearly any object placed on the mirror beneath the stage, thus small portraits, the seconds dial of a watch, etc., are reproduced in each lens, and afford much interest. The recent eyes of insects are also interesting as opaque objects, but soon lose their beauty on account of *post mortem* changes, which render them black. Opaque objects of rare beauty, like some of the green weevils, may be got by sweeping a bed of nettles with a bag-net of muslin; these keep their brilliant color for years. They should be mounted in a rather deep glass ring cell, the bottom and sides of which have been painted with a dead black varnish. When this is thoroughly dry, the weevil may then be set upright on its legs, the abdomen being attached to the bottom of the cell by a small portion of the wax and Canada balsam cement. This will form a good and tenacious attachment. The legs may be arranged in their natural positions, and the cell covered with a circular glass cover, just tacked in two or three places with the wax and Canada balsam. This will keep the cover safe, and should it become dewed by any exhalation, either from the

varnish or the body of the insect, it is readily removed, wiped, and replaced. It is always a good plan to mount opaque objects after this manner.

Not the least interesting study is that of the parasites of different birds and animals. They may be found in infinite variety, every host being the entertainer of strange and wondrous forms of life. A reference to Denny's Monograph will afford some insight into the abundance of parasites infesting animal life, all of which can be readily mounted in balsam, after a preliminary clearing in carbolic acid. It is only necessary to take a canary cage infested with "lice," when an extensive gathering may be made of the *Dermanyssus avium*. Examine a pigeon or domestic fowl, and numbers of its parasites can be got. If a bird or a small animal is killed, and whilst warm is placed on a sheet of white paper, its parasites will begin to leave as the body cools, and may then be readily collected. The acaridæ or mites present an infinite variety of beautiful forms, which an examination of the splendid Monograph published by the Ray Society will testify.

Reports on the Postal-Club Boxes.—XI.

By QUEEN MAB.

The efficient management of the Postal Club during the past year has secured for it the usual degree of prosperity. Twenty-three has been the number of circuits into which the membership has been divided, and these have received from twelve to seventeen boxes each. The absence of notes from the appendix rendered this report somewhat briefer than usual. This is to be regretted, as these appendices are valuable for reference. It is hoped that the next appendix will be unusually good, and contain the notes contributed during two years. A list of members just issued is of much value.

Box R is of more than usual interest, because of the unusual fullness of its notes and the number of its illustrations. This last feature, the illustrations, is worthy of more general adoption. Drawings or photomicographs in these days of cheapened and simplified apparatus are practicable for every one. Dr. S. G. Shanks—"S. G. S."—and other expert microscopists have done much to aid beginners by their explanations of the various preparations in plain, untechnical language. In describing contributions, details, succinctly stated. are very useful. What is a plain, every-day fact to one individual, may be quite outside the horizon of another.

No. 1. Intestinal Worm of Fish.—J. Michels, of New York, says: "There was an outcry in the New York papers about *Trichina spiralis* being found in large numbers in fish. As these parasites are not found in cold-blooded animals I knew the report to be absurd, but I went to Fulton market to find what the trouble was. I found that many fish were loaded with countless numbers of the form shown in the slide. It seems to be a harmless Entozoa of the order Nematodea, and as it appears only in the intestinal tract, it would be removed when the fish was cleaned—not much like a Trichina." The Connecticut river shad has long been renowned as a toothsome fish, but has been a tabooed one on the writer's table since witnessing the writhing mass

of intestinal worms which the cleaning of a freshly-caught shad revealed. Nor does the writer consider cod a greater delicacy since purchasing what was recommended as unusually fine steak. When this fish was brought out to be prepared for dinner there were worms, which had deserted their companions and freed themselves from the fish, wriggling around on the plate, fully three inches in length, one of which is still preserved in alcohol.

Prof. Verrill in his Report on the Invertebrate Animals of Vineyard Sound, says that internal parasites are found in most kinds of fishes, chiefly in the stomach and intestines, but also very frequently in the flesh. They belong to four very distinct orders, Nematodes, or round worms, related to the *Trichinæ* of man and the hog, one or more species of which is found in the intestines of nearly every kind of fish, one, two, or three inches in length, being frequently found coiled up in the flesh of cod, flat worms, the flukes or *Trematodes*, the *Acanthocephala* or the ray-headed worms, and the *Cestodes* or tape worms. Parasitic worms are most common in the voracious fishes, and among the edible fishes, in salmon, cod, blue-fish, and haddock.

Slide No. 2, a filmy fern from Jamaica, Trichomanes lucens, showing involucre and sporangia, bleached in Labaraque's solution and mounted in glycerine after being double stained in carmine and aniline green. Mr. E. B. Grove, of New York, the preparer, says that he has been unable to find aniline green dye which stained uniformly, and did not bleach in the subsequent processes of dehydration, etc.

Slide No. 3, a transverse section of human medulla oblonga. This was prepared by G. R. Elliott, M. D., New York, by Weigert's hæmatoxylin method, and is accompanied by copious notes and a drawing.

No. 4, section of kidney of a rattlesnake. This is certainly a model contribution, both as to the preparation, drawings, fullness of description, and legible chirography. It is by the late Dr. M. N. Miller, of New York, whom the managers in a short note characterize as having been one of the most faithful friends and members of the Club. The mount is hardened with Müller's fluid followed by alcohol, stained with hæmatoxylin and mounted in turpentine dammar.

No. 5, by Dr. H. N. Briggs, of Carnegie Laboratory, is cholera comma-bacillus from culture from patient suffering from Asiatic cholera. Dried on slide, stained with methyl violet, mounted in balsam, and should be viewed with a $\frac{1}{12}$ or $\frac{1}{18}$ oil immersion lens.

No. 6 is a carbon taken from an Edison incandescent lamp, contributed by H. L. Brevoort, of Brooklyn, N. Y. The incandescent lamp employs a filament made in this case from bamboo. The bamboo is cut to shape and is then carbonized. After this, it is usually treated by heating it with a current while in the presence of some gas or liquid capable of depositing carbon on the filament. This is done to give the proper electrical resistance. The carbon filament is next placed within a glass globe, the air from which is pumped out, and finally the globe is sealed. Various substances besides bamboo have been used, but the greater number of lamps made to-day are bamboo lamps.

A Review of the Methods of Demonstrating the Flagella on Motile Bacteria with Special Reference to the Staining Processes.*

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There is, perhaps, no element in the known structure of micro-organisms that is more difficult to demonstrate than the flagella of motile bacteria. Ehrenberg was among the first of the earlier investigators in this field to infer from the discovery of a vortical action in front of a large motile spirillum (*S. volutans*) that its movements were produced and controlled by a pair of fine flagella, one at each end of its spiral body. With the improved microscopical apparatus, Cohn (1) succeeded in demonstrating the presence of the supposed flagella on this spirillum, and his discovery was confirmed shortly afterwards by Dallinger, Drysdale, and others. This fact suggested the idea that all motile bacteria depended for their movement on similar motile filaments.

Dallinger and Drysdale (2), basing their work upon the fact that the minuter monads are provided with one or more flagella, turned their investigations to *Bacterium termo* to determine whether or not there existed a flagellum or flagella on that bacterium. For this work a 1-16 inch Powell and Lealand immersion lens was employed, and special care taken to secure the best possible illumination. The specimen examined was prepared by adding a bit of culture of the bacterium termo grown in Cohn's nutritive fluid to a drop of distilled water on a slide and covering it with an extremely thin cover-glass. The examination was continued incessantly for nearly five hours, when a flagellum was distinctly seen at one end of each of two termo that were moving slowly across the field. The flagella, as seen on the moving germs, were exquisitely delicate and constantly lashing. Other large motile bacteria were subsequently found to possess similar flagella.

The difficulty in detecting the flagella on motile bacteria in a fresh condition is well illustrated by the above briefly-described experiment. It is also a fact worthy of note that the flagella have been seen by this process only on the larger saprophytic forms, and that the smaller and especially the pathogenic germs could not be considered as possessing flagella, except from analogy, until other methods had been devised.

Dr. R. Neuhauss (5) reports a successful demonstration of the flagella on the comma bacillus by means of photography. A culture of this bacillus in meat broth was allowed to grow for four weeks, when it showed, instead of the ordinary delicate comma bacilli, large, thick bacilli and long spirilla. Most of these had lost their motility, but a few germs were still capable of movement. A preparation was made by adding a small quantity of this culture to a drop of distilled water on a slide and covering it with a thin cover-glass. In this condition they were photographed, and a negative obtained which showed a delicate spiral flagellum attached to a short, much-curved bacillus. Other successful negatives were also obtained from the same field by focusing.

It is, however, through the development of staining methods that the demonstration of these hair-like appendages on the great majority

* Read before the Washington Microscopical Society, February 20, 1891.

of motile bacteria has been made possible, and, in many instances, comparatively simple. The discovery of a process by which these minute structures could be stained was first made by Koch, who, after a long series of negative experiments made with the ordinary dyes employed in staining bacteria, finally succeeded in staining the flagella on a certain number of saprophytic forms by using a solution of the extract of logwood. Since then other methods have been devised for staining the flagella on pathogenic as well as saprophytic bacteria, so that now we are able to demonstrate their presence on nearly all known motile germs. The development of these methods has been attended with much interest, for each step in advance has been taken only after long and patient study, and each in its turn has been to a greater or less degree the foundation for the succeeding one. In reviewing the various methods, I shall give them in a form as condensed as possible, assuming that the ordinary technique in staining bacteria is somewhat familiar. It is but just, however, to note that each author to be referred to gives a very full account of his experiments, and, in nearly every case, the experiments and results which led to the formulation of the method finally recommended. Although of much interest in the history of the development of the latest methods, the unsatisfactory processes will, as a rule, be omitted at this time.

Koch's Method.—Koch (4) employed as his staining fluid a concentrated aqueous solution of the extract of logwood.

The bacteria and their flagella were stained by applying this staining fluid in two different ways: (1) By adding the solution to a small quantity of the germ-containing liquid. (2) By making cover-glass preparations, by the ordinary method, from the germ-containing substance, allowing them to dry in the air, after which the film on the cover-glass was covered with the staining solution and allowed to remain for a considerable length of time. The cover was then rinsed in water and the preparation mounted in glycerine. The flagella were stained a beautiful brown. In order to retain the flagella in a stained condition the preparations were treated, prior to mounting, with a weak solution of chromic acid or with Müller's fluid. The stained cover-glass could be allowed to dry and mounted in balsam. By this process Koch preserved a specimen of the *bacillus tremulus* which showed both the spores and flagella.

Neuhauss' Method (5).—This method was devised with special reference to the staining of the flagella of the *comma bacillus*. It is as follows:

The dried cover-glass preparations of a culture of this germ were boiled five minutes in common (Kaiser) black ink, after which they were placed in a weak, warmed solution of chromate of sodium for fifteen minutes. This process was repeated two or three times. Upon examination very delicate lines could be seen extending from the ends of some of the bacilli, but they were so indistinct that the author could not positively affirm that they were flagella. It was this failure to satisfactorily stain the flagella of these germs that led Neuhauss to employ photography as a means of demonstrating their presence, as previously noticed.

Loeffler's Method. I.—Prof. Loeffler (6) was the first to apply the principle of a mordant in the staining of the flagella and cilia of micro-organisms. He succeeded in staining the flagella on a large number of motile bacteria by subjecting the preparations to the action of a mordant before they were brought into the staining fluid. The procedure recommended is essentially as follows:

The Mordant.—To 10 c.c. of a 20 per cent. solution of tannin a sufficient quantity of an aqueous solution of the sulphate of iron is added to give to the fluid a dark violet color. To this is added 3 to 4 c.c. of a logwood decoction (1 part wood, 8 parts water). The liquid will now have a blackish violet color. Care must be taken not to add an excess of the logwood as it would interfere with the staining process. When prepared the mordant should be kept in a well-stoppered bottle, and in order to preserve it, 4 to 5 c.c. of a 5 per cent. solution of carbolic acid may be added.

The Staining Fluid.—To 100 c.c. of a saturated watery solution of aniline oil is added 1 c.c. of a 1 per cent. solution of sodium hydrate to give to it a slightly alkaline reaction. This alkaline aniline water is poured into a flask in which has been placed 4 to 5 grams of powdered methylene blue, methyl violet, or fuchsin. The flask is vigorously shaken and closed with a tightly-fitting rubber cork. This solution can be kept for a considerable length of time. It must always be filtered before using.

The material to be examined must form a very thin layer upon the cover-glass. If the germ-containing substance is albuminous, a very small quantity of it is added to a drop of sterile distilled water on a cover-glass and thoroughly mixed with it; a small quantity of this is conveyed to a second cover-glass and treated in a like manner; and again from the second a third preparation is made. By this treatment the albuminous substance is sufficiently diluted, and the microbes are isolated in a watery medium. The preparations are allowed to dry in the air, after which the films are fixed by passing the covers, film upward, through a flame in the usual manner.

A few drops of the mordant are poured over the film and the cover-glass held over a flame until the fluid begins to evaporate. It is then removed from the action of the flame, and after a very short time the mordant is washed off in a stream of distilled water. Care should be taken to remove all traces of the mordant from the edges of the cover-glass, as it would form, if present, a very troublesome precipitate with the staining fluid. The next step is to filter a few drops of the staining fluid upon the film. This is allowed to act for a brief time, when the cover-glass is held over a flame and gently heated. Better results are obtained if the staining fluid is only slightly warmed and allowed to act for a longer period. As soon as the film becomes darkened (a blackish red if fuchsin is used) the stain is washed off in distilled water. The preparation is now ready for microscopical examination. This can be made at once in a drop of distilled water, or the preparation allowed to dry and mounted in balsam.

The microbes with their flagella should be deeply stained, resting upon a colorless background if the germs are in a purely watery medium, but if albumen is present they are surrounded by a uniformly feebly stained medium, the intensity of which depends upon the quantity of albumen present. With this process Loeffler succeeded in demonstrating the flagella on a large number of motile bacilli, spirilla, and upon the motile micrococcus recently described by Ali Cohen.

Trenkmann's Method. I.—Soon after the publication of Loeffler's method, Dr. Trenkmann (8) announced his process of staining flagella, which in principle is similar to Loeffler's, but differs from it in the composition of the mordant and staining fluid used, and in several of the lesser important details in its application. It is as follows:

The cover-glass preparations are prepared in the same manner as Loeffler prepared his. After they have been dried in the air they are placed (without passing them through a flame) in a fluid composed of 1 per cent. tannin and $\frac{1}{2}$ per cent. hydrochloric acid and allowed to remain in it for from 2 to 12 hours. They are then washed in water and transferred to the staining fluid. This consists of a weak solution of dahlia (2 drops of a concentrated alcoholic solution of dahlia to 20 drops of water). Fuchsin, gentian violet, methylene blue, methyl green, Vesuvian, or Victoria blue may be used. The preparations remain in the staining fluid for from 1 to 4 hours, when they are rinsed and examined. The flagella are stained with any of the aniline dyes, but more satisfactory results are

obtained with dahlia, fuchsin, or methyl violet. The most desirable stain is carbol fuchsin (2 drops of a concentrated alcoholic solution of fuchsin to 20 drops of a 1 per cent. solution of carbolic acid).

In a second process recommended in the same article catechu was employed. An excess of powdered catechu was placed in water and allowed to macerate for several days and filtered. The filtrate impregnates the flagella somewhat feebly without the addition of an acid. The cover-glass preparations, prepared as above, are placed in a solution composed of four parts of the filtrate and one part of a 5 per cent. solution of carbolic acid. They are allowed to remain in this for from 2 to 12 hours, after which they are stained in the same manner as by the first process.

A third process is recommended, which consists in placing the cover-glass preparations in a concentrated solution of logwood for from 2 to 12 hours, after which they are washed and stained in some of the aniline dyes. Fuchsin is especially recommended. The addition of an acid is said to improve the mordant properties of the logwood solution. The acids proposed are hydrochloric ($\frac{1}{2}$ per cent.), gallic ($\frac{1}{2}$ per cent.), or carbolic (1 to 2 per cent.).

Trenkmann also obtained positive, though less satisfactory results, by three other methods of procedure. (1) The preparations are transferred from the solution of the extract of logwood to Böhmer's or Grenacher's hæmatoxylin solution. (2) The specimens are first treated in gallic acid and then stained with some of the aniline dyes. (3) The preparations are treated first with hæmatoxylin solution and then with an aniline dye.

By the use of these methods he was able to demonstrate the tufts of flagella on many spirilla, especially the *spirillum undula* and a water bacillus.

Loeffler's Method. II.—About one year after the publication of his first method, Loeffler announced (7) a second process for the staining of flagella which is a marked improvement over the procedure first recommended. In his careful investigation into this subject he succeeded in discovering an important principle by the observance of which it is supposed that the flagella on all motile bacteria can be stained. *This consists in the degree of acidity or alkalinity of the mordant.* In applying this principle he found that those germs which were acid-producing organisms (those that will change an alkaline medium to an acid one during their development), such as the *typhoid bacillus* and others, require an alkaline mordant, and that the alkaline-producing organisms (those that convert an acid into an alkaline medium during their development), such for example as the *comma bacillus*, the spirillum of Finkler-Prior, the bacillus of blue milk and others, require an acid mordant. The degree of acidity or alkalinity of the mordant necessary to secure the staining of the flagella of a specified germ must be determined by actual experiment; when this is accomplished the method does not differ materially from that first proposed. The formulæ for the preparation of the mordant and staining fluid, together with the details in their application, are as follows:

(1) *The Mordant.*—To 10 c.c. of a 20 per cent. aqueous solution of tannin 5 c.c. of a cold saturated solution of the sulphate of iron and 1 c.c. of an aqueous or alcoholic solution of fuchsin, methyl violet, or "Wollschwarzlösung" are added. The fuchsin is especially recommended.

The foregoing solution is to be regarded as the standard or stock solution to be used, and one which is successfully employed in staining the flagella of certain micro-organisms; but for others the addition of an acid or alkali is necessary. Thus for the comma bacillus it is necessary to add to the 16 c.c. of mordant $\frac{1}{2}$ to 1 drop of a solution of sulphuric acid equivalent to a 1 per cent. solution of sodium hydrate; for the spirillum rubrum 9 drops of the acid solution are required. For the typhoid bacillus 1 c.c. of a 1 per cent. solution of sodium

hydrate must be added to the 16 c.c. of mordant. The bacillus subtilis requires 28 to 30 drops and the bacillus of malignant œdema 36 to 37 drops of the sodium solution. By first determining whether the germ in question is an alkali or acid producing organism the necessary quantity of the acid or alkali solution to be added to the mordant can easily be determined.

(2) *The Staining Fluid.*—The staining fluid here recommended is ordinary neutral aniline water in which fuchsin crystals are dissolved to saturation. As the aniline water is very nearly neutral a saturated solution of fuchsin in it is sufficient. Better results may, possibly, be obtained by adding to this as much of a 1 to 100, or still better 1 to 1,000 solution of sodium hydrate, as it is necessary to bring it almost to a point of precipitation.

Cover-glass preparations should be prepared from a pure culture (agar or gelatine) of the germ to be studied in the manner recommended in the first process to eliminate all albuminous material. Sterilized hydrant water is preferred to distilled water for diluting the culture. It is of the utmost importance that the cover-glasses should be free from all grease or other impurities. In order to clean the cover-glasses they are boiled in sulphuric acid, washed in distilled water, immersed in ammoniated alcohol, from which they are dried on clean linen. The film on the cover-glass is fixed by heat, but care must be taken not to overheat the preparation. The desired amount of heat can be obtained by holding the cover between the thumb and index finger over the flame, instead of passing it through the flame by means of forceps. By this method over-heating is avoided. After heating, the film on the cover-glass is covered with the mordant and held over a flame until steam is given off. It is then removed from the flame and after ½ to 1 minute the cover is rinsed in water, then in absolute alcohol, and again in water until the mordant is completely removed. The film is then covered with a few drops of the staining fluid, and the preparation again heated until the solution begins to vaporize. It is then removed from the flame, and, after allowing the stain to act for about 1 minute, the cover is washed in a stream of water. The preparation can be examined immediately in water, or allowed to dry and mounted in balsam.

By this method Prof. Loeffler demonstrated the flagella on a large number of both saprophytic and pathogenic bacteria. On some of these tufts of flagella are observed, while others possess only one flagellum at each extremity. His paper is illustrated by eight photographs of different bacteria studied by him, on each of which the flagella can be plainly seen.

Trenkmann's Method. II.—Loeffler's second process was soon followed by Trenkmann's modification of his (Trenkmann's) method (9), in which he introduces iodine water to be applied to the preparation immediately after the mordant. This is based upon the same principle as the use of the iodine solution employed in Gram's method of staining bacteria. This method is thought by its author to be superior to the processes previously announced, because it is more simple in its details and more reliable in its results. The method is as follows:

(1) *The Mordant.*—This consists of a 2 per cent. solution of tannin, to which ½ to ¼ per cent. hydrochloric acid is added.

(2) *Iodine Water.*—This is prepared by adding a small quantity of pure iodine to a few cubic centimeters of distilled water and allowing it to stand, with frequent shaking, for twenty-four hours. The iodine solution used in Gram's method, or a drop of the tincture of iodine in 10 c.c. of distilled water, may be used.

(3) *The Staining Fluid.*—This is prepared by adding one drop of a saturated alcoholic solution of gentian violet to 10 c.c. of distilled water. To this 40 c.c. of aniline water are added. The solution remains clear. It stains the bacilli and flagella very well, while the background is feebly, if at all, colored.

The cover-glass preparations are prepared with the usual care to avoid grease or dirt upon the glass and to secure the necessary dilution. Potato infusion is used for such germs as will grow in it. Cultures in this medium are to be diluted

5 to 10 times; bouillon cultures, 40 to 50 times, and when the cover-glass preparations are made directly from gelatine or agar cultures a dilution of 100 times is necessary. He employs boiled water for making the dilutions. A drop of a 10 per cent. solution of alcohol is placed on the preparation and the whole allowed to dry in the air. The dried preparations, without being heated, are placed in the mordant, where they are allowed to remain for from 6 to 12 hours or longer. They are then thoroughly rinsed in water, after which they are placed in the iodine water, where they should remain for about one hour. At the end of that time they are again rinsed in water and transferred to the staining solution. This is allowed to act for about one-half hour, when the preparations are rinsed and mounted for examination, either directly in water or allowed to dry and sealed in balsam. With some germs better results are obtained by varying the quantity of hydrochloric acid in the mordant.

Dowdeswell's Method.—In a comparatively recent publication Mr. Dowdeswell (10) states, after referring to the method employed by Neuhauss to demonstrate the flagella on the *comma* bacillus, that it is not difficult to detect the flagella on the comma forms if appropriate but ordinary means are adopted. The optical apparatus required are simply a normal retina, a good objective with a moderate angle of aperture, and good light. He recommends as a staining fluid an aqueous solution of gentian violet, although other aniline dyes will answer quite as well, and for mounting purposes the *acetate of potash.* There are no special directions given excepting that the specimens must be mounted in the fluid mentioned and not in Canada balsam He also affirms that no difficulty will be experienced in staining the flagella on microbes as small as the *bacterium termo.*

From what has already been said it will be observed that the flagella differ to a greater or less degree on the various bacteria on which they have been demonstrated. Dallinger (3) figures the flagella on the *bacterium termo* as two thread-like appendages, one projecting from each end of the rod-shaped germ. Their length is much greater than the long diameter of the germ, but their thickness one-tenth that of the bacterium. He gives the mean average diameter of the flagellum of this germ as 1-204700 inch, which he determined from fifty measurements with each of four different lenses. The flagella on the *spirillum volutans* and several other forms are similarly figured by the earlier investigators. From the plates and descriptions given by Loeffler and Trenkmann it seems that the spirilla and a few bacilli possess one or more thread-like filaments projecting only from the extremities of the organism, but that the greater number of the motile bacteria on which these appendages have been demonstrated are provided with a greater or less number of long, delicate, thread-like filaments. They appear to be given off either single or in tufts both at the extemities and at short and varying intervals along the entire length of the rod-shaped organism. In the stained preparation the flagella appear either straight, curved, or in the form of spirals. Many of them are usually detached from the germs, presumably during the process of preparation, and appear as extremely long, delicate bacilli or spirilla lying between the bacteria. This fact renders it difficult to determine with any degree of accuracy the number of flagella belonging to any particular germ.

The question may naturally arise, which one of the different methods presented is best adapted for staining the flagella on any particular motile germ that may be under consideration? In answer to such a question I would say that Dr. Theobald Smith successfully employed

Loeffler's second method in staining the flagella on both the typhoid bacillus and the bacillus of hog cholera.

I have also found it to give the best results in staining the flagella on a considerable number of motile bacteria. Although the bacillus of hog cholera is an alkali-producing organism, Dr. Smith stained its flagella by using the neutral or standard mordant (11). I have found, however, that the flagella on this bacillus stains quite as well by adding from one to three drops of the acid solution to the mordant, which shows that the range in the reaction of the mordant that can be used in staining the flagella, on this germ at least, is much greater than might be inferred from the method. This is of considerable importance, as it will, if true with respect to all germs, greatly diminish the number of test experiments in order to determine the degree of the reaction of the mordant necessary to be used with the germ in question. With Trenkmann's second process I have been partially successful, but with the other methods I have met with only negative results. Thus far, however, my experience has been too limited to undervalue these methods, or to recommend too highly the one with which I have been, in a measure, successful.

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Cleaning Slides.—If spoiled in mounting, I use a saturated solution of borax in water, in which I soak the slides for a few days, then rinse in clean water. Borax is a solvent for balsam, shellac, and other cements used in mounting, and does not act on the glass like soda, which is often recommended for this purpose.—*E. L. Cheeseman in The Microscope, November, 1890.*

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Compound Eyes.—The development of the compound eyes of Arthropods is discussed by Mr. S. Watase (Johns Hop. Biol. Studies, iv, 287) with the conclusion that they are the result of an ectodermal invagination essentially similar to that of the single eye.

EDITORIAL.

Explanatory.—The managing editor has returned from the Pacific Coast, where he has devoted the past four months to Census Office business. During his absence, the *Journal* has suffered temporarily and hundreds of letters have accumulated. All will be answered as soon as possible. The delayed numbers, which could not be edited and published at so great a distance, are now being put in type, and will follow this issue as fast practicable. The annoyances which subscribers will necessarily feel by reason of this delay are very much to be regretted.

All must be aware that periodicals of a scientific or technical nature are usually published, not for profit, but often at a loss, purely from interest in the cause. This is why they do not always maintain a clerical force, agents, etc., and explains the delay in such emergencies as the present. This incident may help our friends to appreciate some of the difficulties encountered by the missionaries of science.—C. W. S.

—o—

Steady Progress.—Here is an enthusiastic biologist, a hunter of pathogenic microbes, with his 1-15 immersion. He understands cultures and differential staining. He says that he can diagnosticate tuberculosis, cholera, and typhoid fever by means of his microscope and cultures, and he confidently expects that the cure of these and other microbic diseases will be found in some substance that either destroys the causative microbe, or antidotes its alkaloidal product.

There is a man who has spent forty years at the bedside of the sick. He understands the remedial effects of calomel, morphia, quinia. He never saw nor looked for a bacillus. Not long ago he said that he could see no objection to public funerals for children dead with diphtheria, and he asks patients sick with sore throat to breathe forcibly in his face to see if he can scent diphtheria.

Between these two men there is a wide gulf. Between the two extremes there are, in professional circles, men representing every degree of faith and unfaith. Outside of scientific circles prevails the grossest ignorance concerning the whole matter. The newspaper is about the only medium of communication between the savant and the millions, and the latest news is often presented in so sensational a form as to be practically worse than valueless. A simple tonic becomes in headlines, "The Elixir of life." A bit of lymph is expected to restore broken-down lungs. These sensational reports should and do breed distrust. It is not to be supposed that a bacillus may be discovered, described, its rank, habitat, and variations determined, and its by-products thoroughly studied in the space of six months.

The attitude of the philosophic mind towards the bacteriologist should be that of eager, expectant caution. Knowing that ambition and pretence are abroad, we should not with undue haste accept every new "lymph," but, on the other hand, we should throw aside old traditions as soon as the man with the microscope shall have shown them to be false. Compared with what the bacterologist knew ten years ago, the sum of to-day's knowledge is marvelous after all due allowances have been made.—F. B.

MICROSCOPICAL SOCIETIES.

BOSTON SCIENTIFIC SOCIETY,—BOSTON, MASS.

December 23, 1890; 221st Corporate Meeting.—A paper on Blood Corpuscles was read by W. D. Grier. He described the chemical composition of the blood and the changes it undergoes during circulation. The difference in color between arterial and venous blood is due to the fact that arterial is charged with oxygen, which gives it a bright scarlet color, and venous blood is charged with carbonic acid, which darkens it. The venous blood in passing through the lungs, where it is exposed in large surfaces to the air, gives up its carbonic acid and absorbs oxygen, which it in turn yields up to the tissues, taking up carbonic acid and other impurities. Blood does not, as is popularly supposed, consist of a homogeneous red fluid, but is really a transparent fluid bearing in suspension innumerable little bodies called the corpuscles; these are of two kinds, the red, so called, and the white. The red or colored corpuscles are really of a yellowish tinge, but in large numbers look red. In all mammals except the camel family they are bi-concave and circular, but in camels and their allies they are elliptical. The only difference between other mammalian corpuscles is one of size, the human corpuscle being about $\frac{1}{3250}$ of an inch in diameter, and those of other mammals varying in either direction, the smallest being those of the goat and the largest those of the elephant. The size of the corpuscle however is in no sense dependent upon that of the animal. The red corpuscles of birds, fishes, and reptiles are elliptical and nucleated, reptiles having the largest of any animals. The corpuscles of the proteus or "blind fish," being $\frac{1}{400}$ of an inch in their long diameter, and the "hell-bender" or "mud puppy" of the Western States is said to have even larger corpuscles than this.

The second kind of corpuscle is the white, which in healthy human blood exists in the proportion of two or three to the thousand of red discs. They are much larger than the red corpuscles, except in reptiles, where they are smaller; they are round and of a granular appearance. When treated with dilute acetic acid they develop a large nucleus. In anæmic or poor-blooded persons they exist in much greater numbers than in healthy blood.

Mr. Grier described the changes which the blood passes through after being drawn from the body, and touched on the examination of suspicious stains in criminal cases, alluding to the testimony of Prof. Wood in the Sawtell trial. The paper was illustrated with photographs of blood corpuscles made by the lecturer and diagrams of the circulation, etc. Mr. John Clacey then gave a description of the various steps in the cutting and grinding of telescope lenses.

SAINT LOUIS CLUB OF MICROSCOPISTS—FRANK DAVIS, *Sec'y.*

Jan. 8, 1891.—The following officers were elected for the coming year: J. C. Falk, M. D., President; A. C. Speth, Vice-President; Frank Davis, Sec'y; Otto Meyer, Treasurer; Wm. Ilhardt, Curator.

Mr. Meyer exhibited slides of sachet powders and of *Fucus versicolosus.* Dr. H. M. Whelpley exhibited a specimen of peacock silver and several other mounts of interest. Several applications for membership were received.

NOTICES OF BOOKS.

The Evolution of Sex. By Prof. Geddes and J. Arthur Thompson. The Humboldt Publishing Co., 28 Lafayette Place, New York.

Such a work as this, written by Prof. Geddes, who has contributed many articles on the same and kindred subjects to the *Encyclopedia Britannica*, and by Mr. J. Arthur Thompson, is not for the specialist, though the specialist may find it good reading, nor for the reader of light literature, though the latter would do well to grapple with it. Those who have followed Darwin, Wallace, Huxley, and Haeckel in their various publications, and have heard of the later arguments against heredity brought forward by Prof. Weissman, will not be likely to put it down unread. The authors have some interesting ideas to state, particularly with regard to the great questions of sex and environment in their relation to the growth of life on earth.

SUBSCRIBERS' NOTICES.

THE BAUSCH MICROMETER GAUGE.

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The Full Utilization of the Capacity of the Microscope.

BY EDWARD BAUSCH,

ROCHESTER, N. Y.

[Read at the American Society of Microscopists, Detroit, Mich., 1890.]

[SEE FRONTISPIECE.]

The cover-glass may truly be called a necessary evil; for, while absolutely required in microscopical investigations, there is no adjunct to the microscope that has been and is productive of so much evil, and has retarded the utilization of benefits made possible by the advance in the construction of objectives so much as it. This fact was appreciated as early as 1837, when the angular apertures were what would now be considered extremely limited, and the appreciable effect of variations in thickness of cover-glass was not then nearly so pronounced as it is at the present time, even in modern objectives of a narrow angle.

The accommodation for the different thickness was obtained by varying the distance between the systems of objectives, and has been followed with modifications in the mode of obtaining the necessary motion up to the present day. While open to some objection, it accomplishes the purpose quite satisfactorily and must continue to be used until something better is suggested.

One of the purposes of the homogeneous immersion is, as we know, the avoida ce of the necessity of the cover-correction, in that the cover-glass immersion fluid and front of objectives are to be one homogeneous mass; but even under these conditions, which in practice were found to be not constant, it has been found advisable to provide cover-correction to obtain the highest possible results. However, even should this not be found necessary in the development of improvements in this class of objectives, it must be remembered that the majority of objectives will always be dry, and especially so when such improvements, which we hope are still to be made, are accomplished. It is an unfortunate circumstance that with this class of objectives the influence of variation in

thickness of cover-glasses is most apparent; but since it is so, we should, if possible, provide an agency which, eliminating the personal factor of efficiency, will give, under all conditions, results closely equal to those under which the objectives were originally corrected.

It is surprising to see how little attention is paid to this subject in the large majority of standard works on the microscope. Almost all books give carefully-prepared illustrations and descriptions showing the effect on the course of light by the interposition of the cover-glass, and after giving conclusive evidence of its disturbing influence, still, in a general way, say it is of little moment. Thus, in a German work of the highest standing, which has also been translated into the English language, is found the following utterance, freely translated:

"In regard to modern microscopes, which we have had opportunity to examine, we have not found the difference in thickness such as occurs in commercial cover-glass, when, for instance, three to six are equal to a mm., has any noticeable influence on the microscopical image."

In another work of great popularity are found the following quotations: "That the effect of thickness of cover-glass has a great influence on the perfection of the microscopical image is beyond the slightest question, and certainly deserves the most careful attention of the optician as well as the observer; but whether the devices of its removal are of such great importance and so absolutely necessary as it is claimed, is another question. On the other side, the difference in the cover-glass used in different directions for the most delicate preparations is hardly of any account. I at least possess, besides my individual preparations covered with glass of about 1-5 mm. thickness, a collection of objects which I obtained from London and Paris, in which there is such a slight difference of cover-glass thickness that I can observe them all with my objectives of powers from 2.0 to 1.3 mm. (equivalent to about 1-12 to 1-20 inch) without showing the slightest difference in optical qualities and in the definition and clearness of the image under the same illumination, as I have convinced myself by careful comparative tests."

With such statements to guide the microscopists, it is not surprising that the subject should have received so little attention, and that any efforts to lead to improved methods of manipulating objectives should have almost completely failed because of a lack of the true understanding of their need and consequent failure to create interest. The belief is quite general that any time devoted to this subject is wasted and might better be utilized in other directions. I hope to be able to show that this is entirely wrong, and may here say that, while I may be considered an extremist in the other direction, my efforts emanate from the desire to put it in the power of every microscopist to obtain the highest possible results from his optical battery and equal to those obtainable by the optician.

When in 1887 Prof. S. H. Gage addressed a circular letter to all opticians in the world inquiring for the dimensions of their standard tube length, as well as for the thickness of cover-glass which they used as a standard in the correction of objectives, I looked forward to the result with considerable interest, as it would bring together data which it was impossible to obtain otherwise.

At the meeting of this society in 1887, at Pittsburgh, he gave the results of his efforts, which show some astonishing facts. I would here

say that while for a long time I had felt that a system that would permit the full utilization of the optical capacity of objectives of different makers under varying conditions of cover-classes was desirable, I was then forcibly impressed with the absolute necessity of a plan which would offer this advantage. Outside of the differences of the lengths of tubes used by different makers, which is also of great bearing on the spherical correction of objectives, one is astounded by the difference in standard cover-glasses used by different makers in correcting non-adjustable objectives. With a thickness of 0.10 mm. for the thinnest and 0.25 mm. for the thickest, it is only too apparent that with the additional variation in lengths of tubes it is beyond the power of the microscopist to obtain even approximately the best results from his objectives. More than this, a large quota of the advance made in recent years in the capacity of objectives has been lost.

As Professor Gage states, "A uniform thickness for cover-glass for non-adjustable objectives seems also desirable," and this would be the easiest solution of the question; but while on the one hand the makers of objectives have not yet agreed to use one standard on account of the technical difficulties involved in departing from their established precedent, on the other the microscopist would hardly be willing to bear the expense which would be occasioned by the loss of cover-glass not conforming to the standard in order to use those of one thickness. This expense might be greatly reduced by using selected covers of one standard on objects for all medium and high power objectives and the balance on all other preparations on which only low powers would be used, but this would of course be of little avail in face of the fact that manufacturers follow no standard.

The greatest difficulty is met with non-adjustable objectives. As is well known, compensation for thickness may be obtained in the proper adjustment of tube length; but while not all microscopes are suitably provided with draw-tubes, the requisite experience and skill is lacking with a large number of microscopists to properly make the correction in this manner, as well as in objectives specially provided with collar correction. I am sure that microscopists of long experience will bear me out in the statement that results with adjustable objectives depend upon individual skill, and that many such objectives now in use fail to give results corresponding to their capacity. It would seem, therefore, that any system to permit the full utilization of the capacity of objectives should depend on no personal factor—in fact, should be mechanical—and this I have followed out in the system I shall explain.

In an objective corrected for normal thickness of cover-glass there will be spherical over-correction with thick covers and under-correction with thin covers, the amount of correction varying in a different ratio to the amount of variations from the normal thickness. The chromatic correction will also lose correspondingly, but to not so high a degree. While a deviation of a few hundred millimeters in either direction will, perhaps, not signify, that which occurs in covers classified in price-list under one number is sufficient to seriously affect and the high powers totally obliterate the definition which under normal conditions it may possess. The microscopist is therefore not obtaining such results as his objectives ought to enable him to obtain, and the efforts of the conscientious optician to provide classified objectives of reliability and

similar performance is almost entirely nullified. In making the necessary experiments some astonishing results appear. With a non-adjustable dry 1–5 corrected for a cover-glass of 0.16 mm., employing the extremes of cover-glass which are used by the various manufacturers as standard, as obtained by the efforts of Prof. Gage, I found that for 0.25 mm. a tube length of 6 inches is required to obtain the proper correction, while for a thickness of 0.10 mm. 13 inches of tube length is necessary. In a 1–8 objective adjusted under the same conditions $4\frac{1}{2}$ inches is the requisite for a cover of 0.25 mm., and for 0.10 mm. 15 inches. The further fact is shown that with a 1–5, which, under conditions of tube length and cover-glass given above, shows certain structure, well defined, absolutely fails to show anything of it under a cover-glass of 0.10 mm. on one side, and 0.25 mm. on the other, and further a marked chromatic over- or under-correction. With a cover of 0.14, which would seem but a slight variation from the standard, the objective is spherically highly under-corrected, and with 0.18, highly over-corrected. With objectives of high power the difference is still more marked. For these experiments I have had Mr. J. D. Moeller, of Germany, mount a series of *Pleurosigma angulatum* dry and *Amphipleura pellucida* in balsam, under a series of covers varying from 0.10 mm. to 0.34 mm., each carefully measured and marked. I have used these objects because they are my favorite tests, and it goes without argument in saying that any preparation showing structure under above objectives will be affected to the same extent by the varying conditions of cover-glass, as these objects and in objects of still finer structure the limit of visibility will be reached correspondingly sooner.

The system which I have devised to aid in overcoming these difficulties depends in the first instance upon a micrometer for measuring the thickness of cover-glass. While the delicate instruments made by M. Grossman, of Germany, are excellently suited for this purpose, they are expensive. I have endeavored to overcome this objection by constructing a plain screw which, while not so sensitive to the touch, is sufficiently so for all practical purposes. The instrument is provided with a stand of japanned iron. Cut horizontally through the top is a thread of $\frac{1}{50}$-inch pitch and $\frac{3}{16}$-inch outside diameter. A recess is cut on the top below the line of the screw and at right angles to it for placing the covers. The one-half of the top of the stand which receives the micrometer screw is slotted longitudinally to the depth of the screw and is provided with a set-screw to take up wear. The other half has the fixed screw, adjustable, however, for final adjustment. The end of the micrometer screw is milled, but of a small diameter, so that no force can be exerted so as to endanger the cover-glass. Fixed on the screw between two nuts is a brass drum with a $\frac{1}{2}$-inch face. A knife-edge index finger is fixed to the top of the stand and projects over the top of the drum. To the outside diameter of the drum is fixed a strip of glazed paper provided with a series of divisions. The first gives the thickness of cover-glass in one-thousandth inches, the second one-hundredth millimeter. The third indicates the proper tube length with various thickness of cover-glass with a non-adjustable $\frac{1}{4}$ corrected under a tube length of $8\frac{1}{2}$ inches and cover thickness of 0.16 mm.; the fourth gives the tube lengths of a 1-5 inch objective under the same conditions; the fifth for a $\frac{1}{8}$, and the sixth for a 1-12 for same conditions of tube length and cover; the seventh is for a 1-6 with the same cover and tube length of 160.0 mm.

In objectives provided with cover-correction the graduation is so arranged as to read to 1-100 mm. No matter what the power of objective or whether dry or water immersion, the number gives proper correction for a thickness corresponding to it. Thus, with a cover-glass of 0.20 mm. the collar of such an objective need merely to be set at 20 to give the proper correction, and, consequently, the best results. On the other hand, with an objective which is graduated on this system the correct thickness of cover-glasses can be determined by obtaining the proper correction on preparations previously made, but on which the thickness of cover-glass is not noted and the thickness may be marked on them for future convenience. To do this successfully, however, the necessary experience is requisite. All the other scales give the correct tube length in inches and millimeter for covers corresponding to them, and in this manner offer a ready and definite means of correction. The tube lengths required for the thinnest and thickest covers are so extreme that probably no convenient means for obtaining them can be practically arranged, but they can be so approximately if not entirely. At any rate, the micrometer will detect the requirements before using the covers, and those deviating considerably from the normal can be used on objects for use with low powers only, in which case the effect will not be very appreciable.

In this system I do not overlook the fact that variation in tube length involves a variation in magnifying power; but, except in cases when micrometers are used, I consider this of secondary importance, as it always is in comparison to results obtained in resolving and defining power.

This system involves four conditions:

First. That all cover-glass be measured before using them, and that the thickness be noted on the preparation.

Second. That for convenience all draw-tubes be marked in inches or millimeters, or both.

Third. That adjustable objectives be corrected according to this scale.

Fourth. That the same tube length and cover-glass thickness be used in all original corrections of objectives.

As regards the first condition, there are many microscopists now who measure all their covers before using them; but the mere knowledge of thickness has been of no value up to the present time, because this in itself has been no guide in obtaining better results except by approximation. My aim in connection with this system has been to devise an instrument which possesses a high degree of accuracy and still be so inexpensive that its price should be no obstacle to its general use.

The celebrated preparer of objects, Mr. J. D. Moeller, and others have kindly agreed to mark the thickness of covers in their objects so as to aid the introduction of this system, and other preparers can no doubt be induced to do so if its advantages can be proven.

As regards the second point, many manufacturers now graduate their tubes, and modern requirements demand that this should be more generally done. Our company intends, as soon as it can possibly arrange to do so, to graduate the tubes of all its instruments.

As to the third and fourth conditions, I cannot, of course, presume to ask manufacturers to adapt their standards to this system. While it will be a convenience to a large number of microscopists, I must leave it to the merits this system may possess to exert their influence in this direction.

Sixteenth Annual Report of the American Postal Microscopical Club.

By R. H. WARD, M. D.,

TROY, N. Y.

Membership.—We have at present 22 circuits, rather more than full; the few vacancies being more than balanced by supernumeraries in other circuits. Most of the circuits are in good condition, with a loyal and efficient membership.

One circuit was dropped at the opening of this season, as the only way of stopping the excessive delays and frequent losses occurring there. It is impossible for the Club to live while retaining any circuit, whoever the members may be, that cannot be safely trusted with the boxes. It is probable that this circuit can be refilled before the beginning of next season; but great caution is necessary, as it is a great disaster to the Club to take in incompetent or indifferent members who will break up our plans, and confuse the whole service, by dropping out in a few months.

This winter we have had the great pleasure of receiving and accepting, from our Mr. John H. Choate, of Salem, Mass., an offer to supply a list of the membership from his printing establishment. What kind of artistic as well as scientific printing they can do in Salem can be seen in the dainty little "booklet" which Mr. Choate not only presented to each member, but also with unexpected liberality furnished in quantity for the use of the Club without charge.

The Slides of the last series of circuit-boxes are unquestionably better, on the whole, than any preceeding set; and as most of the former ones will be withdrawn after this season, the average service cannot but be improved. Few of the recent slides can fail to interest some among the diverse membership; while many of them are positively instructive to all except those few who have got to that stage of learning where they must be content (?), for the most part, with the pleasure of teaching. No expert can safely consider himself above the province of assisting learners; and it is difficult to doubt that work is well spent which calls out such answers as these, some of which were written by acknowledged authorities: "A splendid lot of slides." "Professor * has had this box and note-book and expresses himself very much pleased and interested." "This is an exceedingly fine specimen, and is well worthy of study. It is a whole text-book of itself."

Slides which seem quite uninteresting to some specialists may be really valued by somebody else, as appears from the following expressions appended to various notes: "A rather severe comment. Perhaps * * can recollect doing quite as unsatisfactory work in some part of his existence. * *." "To my mind this object is quite as beautiful and worthy of study as many of the interminable slides of * * now forced upon a suffering microscopical fraternity. * *." "Yea, verily. * *." "I consider this an interesting slide. The views under a $\frac{1}{4}$th are exquisite. Not being a medical expert or a diatomaniac, I have really enjoyed this considerably, and have felt paid for many lost minutes spent on different slides which were enigmas to me. * *." "I am sorry to see this observation. The slide shows one of the objects most interesting to a botanist, and I doubt if * * can

tell how the elastic rings, so characteristically shown in this slide, separate when ripe. If he does, it would be well to have called attention to the little flat cells that are found in the middle of the ring where it always tears apart. * *."

To many circuit secretaries and other members who have kindly repaired or remounted slides that reached them in a damaged condition the Club extends hearty thanks.

The Note-Books have been improved on the average no less than the slides. While even Jupiter nods sometimes, and there are some books, even from a few circuits that generally do best, that are unfortunately too brief, still an unusually large portion of the members gave long and excellent notes on their last contributions, some of the notes being instructive and thoroughly written essays that compare not badly with the printed pamphlets accompanying the Cole slides. Some have generously undertaken to add really good notes or drawings to slides that seemed to need them, though contributed by others. Several of our amateur photographers (especially Messrs. Christian, Line, Ritchie, and Ashby) have added greatly to the value of the note-books by adding numerous photographs of the objects described. The good that these works are doing, and how well they are appreciated, is shown by numerous remarks such as these: "I have learned much from the slide and diagram; thanks." "A very excellent description of a valuable preparation." "Would there were more such painstaking people in this world as * *." "Many thanks to * *. Would that more were like him willing, if not as able, to give information." "I move a vote of thanks to * *." While the desire for fuller information is often shown: "A very interesting slide. Some notes on the habitat or distribution of this species would have been acceptable." "This beautiful mount loses much of its interest by having no intelligible description." "Will some one else help me out, to describe objects and fill these blank spaces? It may help somebody."

The Appendix printed herewith contains a collection of such of the recent notes as are at present accessible to the management, and as are most suitable for publication by themselves. Many equally valuable ones are most instructive in connection with the slides but not equally available for use separately. There is reason to hope that, with the notes now being added to the boxes as they circulate, and to be furnished from time to time, there will be sufficient material for a good Appendix to each year's Report.

Special Boxes Needed.—Members are specially requested to consider the following suggestions and queries thoroughly and at once, and to send such suggestions or offers as may result before the first of May.

No circuit boxes have been sent out to be filled this season, except to those who failed to fill their boxes last season; and none will be, unless required by special and unexpected emergencies. Instead, volunteers having facilities for producing high grade professional work, or for otherwise assisting in this scheme, are invited to send offers of special boxes to take the place of the Cole boxes now in use. Mr. Cole's work, which we have used for years with great satisfaction, is no longer issued with explanatory pamphlets; and when our supply becomes scanty, early next season, we shall be in great need of a satisfactory

substitute. Recent offers of special boxes by Drs. Close and Sylvester, Mr. Hill, and Miss Booth, in some cases including elaborate note-books, have led us to hope that the emergency may be met by an appeal to the experts in the membership of the Club.

Mixed boxes of miscellaneous objects have their value, and their preparation evidently serves to interest beginners and to bring out their powers; but they are useless for the present purpose. Only high-grade work of really instructive character is needed, and only 25 or 30 boxes of that. There is no doubt that among our nearly 140 members we have a sufficient number fully qualified to furnish these boxes if they would take the interest to do so. The slides should not be mixed at random; but each box, or for variety each half of each box, should pertain directly to some one definite field of study. Remembering the hard usage, and the character of our boxes, objects should be very thoroughly mounted, avoiding brittle or uncertain accessories like wax, curtain-ring cells or zinc-white cement, which seldom wear well in our service. Water mounts should be avoided if possible as they often fail, and Pierce cells which often split off, and extra-thick cells of any kind, which nearly always succeed in breaking their own slides or the next ones.

As many may be able to offer suitable slides who cannot conveniently write the note-books, which books should give at least three or four note-book pages (closely written or by typewriter) of careful treatment of the subjects, somewhat after the manner of the pamphlets furnished with the earlier issues of the Cole's Studies; and as others may be ready to write notes or furnish drawings, photographs, or typewriter copies who have no opportunities for mounting, it is proposed to separate these functions if desired, as indicated by the following questions. (It has also been several times proposed and discussed, with many suggestions as to details which we hope may be made valuable, to cut up some text-book, proceedings, magazine articles, or other printed authority, to make up note-books as so successfully accomplished with the Cole pamphlets. The advantages and difficulties of this plan, both very great, will at once occur to every one having experience in the Club work.)

1. Will you fill one or more boxes of two slides each, or of six slides each, as above proposed, and of what class of objects; and with or without full notes, drawings, photographs, and typewriter notes?

2. Will you furnish notes for slides from other members, and how many, and for what class of objects; and with or without drawings, or photographs, or typewriter copies?

3. Will you furnish photographs of slides, or typewriter copies of MS., to be furnished by others; and if so, which and how many?

4. What book (not too large, and well illustrated if possible), if any, would you recommend as suitable to be cut up and worked into the note-books; and would you prefer to contribute your slides, if any, to illustrate it?

5. During which month, from May to September this year, will you carry out your offers; and how much money, if any, will you desire to be repaid by the Club for expenses incurred?

Answers to the above are not expected from all members, but only from those able and willing to assist in some of the ways indicated.

Circulation.—During the last full season, 1889–'90, nearly all the circuits received from 14 to 16 boxes each; only one having as low as 12 or 13 boxes, and a few having 17. During the present season from the first of October to the first of March, more than half the circuits have had the the exact average number of 12 boxes each, while the rest have varied from 11 to 14 boxes. If no unusual losses occur, and the members exercise a reasonable promptness, we may fairly hope to add, on an average, about six boxes more before July 1st, making a total of 16 or 18 for the whole season. This gives an average of something more than two a month throughout.

If members followed the rules with tolerable care, the boxes would very rarely be received at intervals of less than a week or more than two weeks. In those few cases, this season as heretofore, where circuits received no boxes or perhaps only one for several weeks, and then some four or five within less time than that, the trouble has always been needlessly brought, upon those who suffer, by the negligence of their fellow-members. If all had followed the three-day rule, forwarding everything in the same order as received and always three days apart, the lot of those who follow would be a comparatively happy one. Indeed, if all would follow properly every word of the rules, they would be surprised to find how easy and satisfactory it would be, and their neighbors would immediately begin to suspect that they had all become saints.

It is doubtless true that the work at headquarters is not done as promptly as it ought to be; and some members may have taken this as an example showing that rigid promptness is not looked for elsewhere. Exactly the opposite is true. When one or two members are obliged to carry more than half the burden for the whole Club, doing far more of the work than all the other 150 together, it is wholly impossible to do it, by any amount of sacrifice, as it ought to be done; and it can only be done at all by depending upon and receiving the cordial assistance of all. Much of the labor, and more of the delay here, has been caused by carelessness elsewhere.

EXTRACTS FROM THE NOTE-BOOKS.

Zoölogy.

Long Scale (*Mytilaspis gloverii*).—My contribution to the Club, two years ago, was a slide of an insect affecting the orange,—the "Turtle-back" scale. The present slide represents another of our pests, the "Long" scale, socalled from the fact that the armor-covering of the insect is longer than any of the other scales affecting the orange tree. Many members of the Club have no doubt seen on oranges in the markets dark brown objects scattered on the surface of some of the fruit. These are the armor scale of the insect which accompanies this description.

The long scale is the most common of the coccides we have to deal with in Florida, and if it were not for the fact that they have many natural enemies to help keep them in subjection, they would prove a greater pest than they do. One of these friends to the orange-grower is the well-known "lady-bird" insect, which can be seen in more or less numbers on every orange tree.

The armor of the long scale is a thin horny covering usually of an oval shape, tapering considerably at the smaller end; but the insect will conform its covering to the shape of the object from which it draws its nourishment.

The principal thing I wish to call attention to in this slide is the sucking mouth parts, which consist of a bundle of four hair-like tubes that penetrate deeply into the tissues of the host plant or fruit, and once inserted can never after be removed by the coccide, and if removed by violence the insect is powerless to reinsert them and dies of starvation. This particular insect, a female, was taken from an orange with the view of attempting to preserve these slender tubes with it; and with only a few have I been able to remove them as perfect as this one. The insects pass through two molts, at different stages of their existence; and soon after the last one the females are impregnated by the male, and soon reach their full size, about .11 inch. They lay their eggs under their scale armor, and, as they are deposited in regular order, the body of the female becomes much reduced in size.

The males only are furnished with wings, and their sexual organs consist, in part, of the long stout spine at the end of the body, by which it reaches the female under the scale. The armor or covering of these insects consists of a sort of hardened wax, quite tough, and therefore impervious to most liquids. It resists the action of oils and of bisulphide of carbon, and is insoluble in acids or quite strong alkaline solutions; so it will be seen that the long scale is rather a difficult pest to get rid of other than by its natural enemies.—*E. S. Coutant.*

Skin of Chameleon.—The shield-shaped plates composing the skin are evidently laminated and refractive, and they do not lie perfectly horizontal, but from end to end give a slight angle to the horizontal. In this slide the plates lie lengthwise with the glass so that in the usual position of the slide under the objective the degree of obliquity of illumination to the surface of the glass being the same (say 25°) from both sides, right and left, the degree of obliquity to the plates would vary by twice the angle made by the plates with the horizontal. This variation is the occasion of the differences in the refraction of light from the two sides and the consequent marked difference in color; just as in the laminated opal the hue varies with the angle of illumination and observation. If * * * will after placing the slide on the stage in the usual way, rotate the stage 90° and illuminate, right and left, at the same angle, he will see no special difference in the hue of the given plate or plates; since the angle of illumination with the plates in that position is the same right and left.—*A. T. L.*

Section of Human Skin.—The pigmented cells are situated under the outside skin or epidermis. A burn or blister or some such injury may remove some of this pigment and leave a white scar. Some tribes in Africa have the habit when in grief of rubbing the skin of the forehead until rubbed or blistered away; this results in white or nearly white spots or marks.—*S. G. S.*

Supra Renal Capsule.—This body like the tonsil seems to be one of the mistakes of Moses. It appears to be of no earthly use when healthy, but makes no end of trouble when degeneration is pleased to occur. If it were more externally situated so that it could be promptly removed at the first symptom of nihilism, we might be much happier. —*S. G. S.*

Mite-Parasite of House Fly (*Acarus Sp.?*).—This specimen is on a fragment of the wing of the unfortunate fly with its proboscis inserted in a mid-vein where it can suck the life-blood of the fly. Beetles may often be seen absolutely loaded by a species which preys on them. I have seen a fly with nineteen of them. Usually a single fly has but one or two. They seem most numerous in the fall. Place the fly on a shallow saucer with a little turpentine; decapitate the fly and these parasites will generally crawl off and desert the sinking ship.—*L. A. Willson.*

[*To be continued.*]

Hints on Histological and Pathological Technique.

By Dr. W. C. BORDEN, U. S. A.

FORT DAVIS, TEX.

Hardening.—I. Use aqueous hardening fluids, if it is desired to retain the tissue elements in their most unshrunken condition and tissue relations undisturbed.

All hardening fluids, which contain alcohol, when applied directly to fresh tissues, cause them to shrink perceptibly, on account of the rapid abstraction of the water; but when used after the tissues have been fixed by one of the aqueous fluids, such as Müller's fluid or solutions of osmic or picric acid, shrinkage is either entirely avoided or is so slight as not to be detrimental. This is of particular importance in embryological work, as well as in all tissues containing cavities, as there is then less danger of distortion from the unequal shrinking action of alcohol on the different elements, and less likelihood that cavities will assume unnatural shapes. Delicate tissues and embryos, made up as they are of widely different elements, are bound to shrink unequally under the primary use of alcohol, so producing distortion, which leads to erroneous results.

Paraffine Imbedding.—I. In order that the section knife may glide easily and smoothly through the tissue use turpentine to remove the alcohol.

Chloroform and benzole are not as good as turpentine for putting the tissue in the best attainable condition for cutting, as after their use the knife does not pass through the tissue with the oily smoothness with which it does after the use of turpentine. This is of importance where large sections are to be cut, as the minimum amount of resistance to the knife in proportion to the size of the section is in the highest degree desirable. In order that the best results may be had, the turpentine must be used in *large* quantity after *absolute* alcohol, and must be changed once in order to remove every trace of alcohol. *With some methods of in toto staining* (as will be indicated further on) *turpentine should not be used*, and then one of the other fluids must be resorted to, but it is imperative for best results in all cases that the last remnant of water be removed from the tissue by the sufficient use of absolute alcohol before the turpentine or its substitute be applied, and that sufficient of the latter agent chosen be used to entirely remove the alcohol before paraffine comes into contact with the tissue.

II. Do not pass a tissue directly from turpentine, chloroform, or benzole into melted paraffine.

The tissue should be placed for several hours, 24 or more, according to its size, in an intermediate bath of a saturated solution of paraffine in a fluid similar to that last used, as the change to fluids of different densities is thereby rendered less abrupt and liability to shrinkage is lessened. It is well to stand the bottle of saturated solution of paraffine containing the tissue on the top of the water bath used for embedding, where it will be warmed and the penetration of paraffine solution furthered.

III. Use only pure paraffine for embedding.

The mixtures of paraffine and cocoa butter and the mixtures of wax and oil have no advantage over the different grades of paraffine, but, on the contrary, are decidedly inferior, as they are friable and lacking in that cohesion which paraffine possesses, and which makes it such an admirable support for delicate tissues during sectioning.

Any embedding substance which crumbles ever so slightly will not hold the tissue up to the edge of the knife with that firmness which is essential to delicate sectioning, nor will it hold all parts in place after the cut is made. By using paraffines of different melting points, any degree of softness may be obtained, and this with more accuracy than with the mixtures sometimes advised.

IV. When very thin sections are to be cut, embed in hard paraffine.

Thinner cuts can be made from a rigid substance than from a soft, yielding one, and this holds with paraffine as well as with other materials. But hard paraffine, while it will admit of very thin sectioning, will curl hopelessly when cut, unless the temperature of the room is very high, thus practically reducing it to the condition of soft paraffine, or unless the sections be kept flat by the use of a section flattener of some form. For this latter purpose, after having tried most of the mechanical contrivances recommended, I have come to the use of a thin steel spatula held in the hand, and with its end catching the edge of the section just as it begins to curl, thus preventing its rolling up. By this means I find that I can keep large thin sections in better shape than by the use of any flattener attached to the microtome. To be sure, a certain degree of manual dexterity and steady hand are required, but these are easily attained with a little practice, particularly if the microtome be run by foot-power, so leaving both hands free.

When embodying in celloidin, have the last solution very thick.

If the celloidin solution is too thin, or the tissue has not been left in a thick solution sufficiently long to insure its complete penetration, the contraction of the celloidin when placed in diluted alcohol will distort the tissue, and in delicate tissues will even produce rents in the weaker parts.

Sectioning.—I. If the microtome is of the sliding pattern, it is well to run it by foot-power.

This will leave both hands free to manipulate sections, and there will be less liability of the knife jumping, as the force can be more evenly applied than when the hand is used. I have my microtome placed on an old sewing-machine table, and by a suitable arrangement of cords and pulley-wheels a downward pressure of the foot on the pedal causes the knife-carrier to run forward, when, upon removal of the pressure, the carrier is pulled back by a counter weight hung on a cord run over a pulley-wheel at the back.

II. A good "Wade and Butcher" razor is better than most section knives.

A good razor of this make has the properties, so greatly to be desired in a knife for this work, of taking and *holding* a very fine edge. It may be attached to the knife-carrier by means of one of the holders sold for that purpose. It should be of the form known as "half hollow ground," the full hollow ground being too thin back of the edge. The form of a section knife and the way in which it is ground exercises a decided influence on the curling of sections, for the smaller the angle of the cutting edge, *i. e.*, the narrower the back of the knife in proportion to its width, the less the sections will curl. For this reason, as a razor has a narrower back in proportion than most section knives, it does not curl the sections as badly as the latter, and small sections which will curl hopelessly when cut by an ordinary microtome knife will often not curl at all when cut with a proper razor.

Cementing Sections to the Slide.—I. In general, an albumen fixative is the best to use when the sections are to be stained on the slide.

Sections which have to be passed through aqueous fluids after cementing are less liable to wrinkle and separate from the slide than those cemented with other substances, notably collodion, and they also take staining fluids much more readily. After cementing with collodion staining is often difficult, the collodion preventing proper action of the stain, probably because a thin and nearly impervious layer of it is deposited over the tissue elements. For these reasons an albumen cement is generally to be preferred when the staining is to be done on the slide, but it presents no advantages over other cements when the staining has been done before sectioning. It has, however, the disadvantage of becoming stained itself if used too liberally, or if the staining be forced or too long continued. Proper use of the cement and stain will obviate this in ordinary staining, but it is well to bear it in mind and use collodion when forced methods of staining have to be adopted. Of the albumen formulas, that of Mayer in my experience has the best keeping qualities. It is made by beating together thoroughly with an egg-beater: White of egg, 100 grams; glycerine, 100 grams; sodium salicylate, 2 grams; and then filtering. The filtration is very slow, but in course of twenty-four hours sufficient will have passed through to last a long time.

II. Use the finger to flatten sections on the slide.

The finger must be thoroughly cleaned by wiping with a cloth moistened with alcohol, as any trace of oil will cause the section to adhere to it, instead of to the slide. Small sections may be flattened by pressure after the entire section has been laid on the slide; but large ones are best smoothed out by taking them up on a small spatula, letting one edge touch the slide, and then following the spatula up by pressure from the finger as it is gradually withdrawn from under the section. If the flattening is thus done gradually and carefully, during the application of the section to the slide, perfect smoothness may be attained, but if the flattening process is not attempted until the entire section has been laid on the slide, the edges will be apt to adhere, and, instead of its spreading out smoothly, folds will be formed.

Staining.—I. Adapt the staining to the hardening process which has been employed.

Tissues hardened by almost any method usually take hæmatoxylin

stains well, though those left too long in chromic acid solutions may prove refractory, unless very strong solutions are used. Of the many different hæmatoxylin dyes, none have given me such uniformly good results as the one made by adding Merck's hæmatoxylin, a few grains at a time, to a hot saturated aqueous solution of common alum, contained in a porcelain capsule, boiling slowly for fifteen minutes, adding sufficient water to make up for evaporation, exposing to the air for a few days in a wide-mouth bottle in which has been placed 30 grains of camphor, and filtering each time before using. The quantity of hæmatoxylin added may be varied according to the strength of dye desired, or a strong solution may be made, and weakened as required by adding a saturated solution of alum.

Like hæmatoxylin, the aniline dyes stain well, irrespective of the hardening methods employed, but carmine acts best with tissues which have been hardened in alcohol, corrosive sublimate, or osmic acid solutions; though alum carmine acts much as the alum hæmatoxylin fluids do, and so stains well tissues hardened in the bichromate and kindred fluids. With it most satisfactory purple stains may be obtained, but the bright reds, given by other carmine stains, are often difficult to attain in sufficient density when a bichromate or chromic acid fluid has been used for hardening.

II. Use ordinary tap and not distilled water for washing tissues stained with hæmatoxylin.

Ordinary tap water is slightly alkaline, and changes the color into a deep, bluish purple, while distilled water leaves the sections with a rather disagreeable reddish tinge. Also any trace of acid in any of the fluids through which the sections have to pass after staining will produce the same reddish color, so that it is well to make them faintly alkaline by the addition of a small quantity of sodium bicarbonate.

III. Never pass tissues stained by an alum stain (*e. g.*, alum hæmatoxylin or alum carmine solutions) through turpentine.

Turpentine in some manner destroys all alum stains, generally slowly, the turpentine still acting even after the section has been mounted in balsam.

If tissues are stained in mass with an alum stain, and are afterward passed through turpentine before imbedding, the sections will be found to be partially decolorized and the brilliancy of the stain entirely destroyed. For this reason it is with such staining that turpentine has to be avoided and chloroform resorted to, and when sections are stained on the slide in alum dyes they should not be cleared with turpentine, but with oil of cloves. As this agent attacks collodion, and so may loosen sections from the slide if cemented with it, the oil of cloves must be allowed to act but as short a time as possible, or an albumen cement must be used. In this connection it is well to remark that balsam should never be thinned with turpentine, but with chloroform or benzole, as these latter have no ill effects on stains.

Mounting.—I. Do not use balsam exclusively as a mountant.

The high refractive power of balsam is in many cases a disadvantage in histological and pathological work, as fluids of lower refractive index allow some of the more transparent parts to be more easily seen and certain delicate tissue connections to be more readily made out. It does not follow that because a section is cut very thin by the celloidin

or paraffine method, and is cemented to the slide, that glycerine or Farrant's medium may not be used, for, on the contrary, they may often be employed with great advantage.

Of the two, Farrant's medium is rather easier to handle, and gives excellent results; and it is a good plan in sections not serial, where, of course, only one medium can be employed with advantage, to mount sections in both it and balsam, for comparison. Advantages may be so gained, not only from comparison, but in making out the structure of the sections.

II. Always finish a mount with cement.

With fluid mountants the need of a cement finish is obvious, but with balsam mounts the necessities for its employment are not generally recognized. One should always be used, however: first, because the balsam will turn yellow if not protected, the yellowness gradually creeping in under the cover-glass, from the edges which are exposed to the air toward the centre; second, because the balsam will ultimately become so hard that a slight jar will cause the cover-glass to fly off.

These different hints are submitted from personal experience, not that they will add anything to the knowledge of experienced workers, but that they may point out to the less expert a few practical means by which failure may be avoided or more satisfactory results obtained.

Microscopy for Amateurs.

By T. CHARTERS WHITE,

QUEKETT CLUB.

[*Continued from page 13.*]

Injection.—When the student has advanced so far in this course, he may undertake the injection of the blood-vessels of such small mammalia as the rat or guinea-pig, with a view to the demonstration of their circulating system. As this is an operation of some difficulty, requiring much care, a knowledge of anatomy, even if it be but elementary in its character, will greatly assist. Injections of the circulating system of such small animals are more easily done from the left side of the heart; and to reach this the directions generally given are to make a longitudinal incision through the *sternum* or breast-bone, and stretch the opening sufficiently wide to get to the heart. This way of commencing is very embarrassing, and affords but small space for the delicate manipulation required at the most critical part of the operation. It is recommended because of fear of the injecting fluid escaping through the intercostal arteries which run across the course of the ribs. But, in a small animal, these are not of sufficient size to make any material loss. They are not to be considered when the advantage of gaining more room is in view. Therefore it is better to make an incision transversely across the thorax, about the distance of six ribs from the *clavicle* or collar-bone. Then, with a stout pair of scissors, cut through the ribs on each side, and remove the front of the thorax in one piece. The lungs, then, apparently fill the whole cavity of the chest; but, on pressing them apart in the centre, the heart, in its pericardial bag, will be found. The *pericardium* may be opened and removed, as may also the greater part of the lungs, unless it is desired to inject

them. Till the student is able to carry out this operation with that perfection which comes of practice, it is better that he should limit his labors to the simple and less demanding process of injecting the arterial system. The apex of the heart may be cut off with scissors, when two openings in it will be noticed; these are *the ventricles*. If a probe be carefully inserted into the lower of the two, that nearest to the vertebral column, it may be made to pass through the valves which guard the entrance to the *aorta* or main artery of the system into the arch of the aorta, which bends over before it gives off its ascending and descending branches. The greatest care must be exercised in performing this operation in a small animal, as the tissues are delicate, and rough manipulation would end in rupture, which would spoil the injection.

Injections may be either transparent or opaque; the latter are but seldom seen now, but were formerly held in high esteem, and may occasionally be met with in old collections. They were made by a process of double decomposition of certain chemical salts, with the addition of size or gelatine, to give body to the injection. Mr. Thomas Davies, in his work "On the preparation and mounting of microscopic objects," gives the following formula for the yellow injecting fluid: Acetate of lead, 380 grains; bichromate of potash, 152 grains; size, 8 ounces. The lead salt is to be dissolved in the warm size, and the bichromate of potash, in powder, is added gradually with a good shaking-up between each addition; or acetate of lead, 190 grains; chromate of potash, 100 grains; size, 4 ounces. The first of these produces the deepest color, and is the most generally used. For a white injection the second salt must be varied thus: Acetate of lead, 190 grains; carbonate of potash, 83 grains; size, 4 ounces. In these combinations a double decomposition takes place, and an insoluble salt is thrown down, a chromate of lead being formed in the case of the yellow and a carbonate of lead or "white lead" formed in the latter. These injections, when made and while still warm, must be strained through fine flannel to reduce the particles to such a degree of minuteness as to enter the capillary system without blocking it, and causing extravasation. Preparations injected in this manner can only be examined under the microscope, as are other opaque objects.

By far the most interesting and instructive are transparent injections; at the same time they are more easily accomplished. Dr. L. S. Beale in his book "How to Work with the Microscope," in giving directions for this operation, recommends the following formula for a blue transparent injection: Price's glycerine, 2 ounces by measure; tincture of sesquichloride of iron, 10 drops; ferrocyanide of potassium, 3 grains; strong hydrochloric acid, 3 drops; water, one ounce. Mix the tincture of iron with one ounce of the glycerine and the ferrocyanide of potassium, first dissolved in a little water, with the other ounce. These solutions are to be mixed together very gradually in a little bottle. *The iron solution must be added to the ferrocyanide of potassium.* Lastly, the water and the hydrochloric acid are to be added; sometimes a little alcohol, about 2 drachms, may be added to the mixture. About six ounces should be made for a rat or small guinea-pig. If properly made this injecting fluid should be entirely free from particles or even granules, and look more like a blue stain than the result of a double decomposition. The author makes it a little more acid than does Dr.

Beale, as in subsequent staining with the ammonia carbonate, unless the blue injection is distinctly acid, all its color becomes degraded, or almost lost after a few years, by the alkalinity of the carmine stain.

Red transparent injections are also recommended as instructive and pretty. The formula given by Dr. Beale will be found to work well, but as it contains gelatine, both subject and solution must be kept warm. Pure carmine, one drachm ; liquor ammonia, two drachms ; glacial acetic acid, one drachm 26 minims ; solution of gelatine (1 part to 6 of water), two ounces ; water, $1\frac{1}{2}$ ounces. Dissolve the carmine in the ammonia and water, and filter if necessary. To this add an ounce and a half of the hot solution of gelatine and mix thoroughly. With the remaining half ounce of gelatine solution mix the acetic acid, and then drop this little by little into the carmine solution, stirring briskly during the whole time. Great care is required in mixing this injection that no precipitation of the carmine takes place by putting in the acid in too large quantities at a time ; and therefore, while mixing, a little should be examined under the microscope, and the addition of the acid solution discontinued in time, should signs of precipitation appear. In carrying out this process there is one condition not to be overlooked, and which, if neglected, will only end in failure, or, at the best, only partial injection. The animal must be freshly killed, and injection commenced before *rigor mortis* sets in, as the rigidity of the coats of the capillaries will prevent that smooth flow of the injecting fluid which is conducive to a satisfactory result.

An Injecting Syringe.—This is a syringe of brass of about two-ounce capacity, having a well-fitted piston working easily, but not too freely, the handle of which is formed of a ring sufficiently large to allow the thumb to pass through, and two rings in which the fingers are placed.

Nozzles.—These, when in use, are firmly fixed to the end of the syringe, and are generally supplied in three or more sizes to accommodate the varying calibres of the vessels to be injected.

A different apparatus renders the operation much less fatiguing and will commend itself as less likely to end in failure from too much force being applied by the hand in syringe injecting. This arrangement consists in two Woolf's bottles placed on a shelf about five feet above the laboratory table ; one of these is partially filled with the injection fluid, and the other with warm weak solution of table salt in water. A bent glass tube, inserted through a cork in one of the necks of the bottle, passing to the bottom acts as a syphon. Two lengths of India rubber tubing and of sufficient length to reach the table should be well washed out, to free them from the particles found in all new tubing. In the free end of each length of tubing is fastened such a stop-cock as is generally supplied with the syringe. A tube may now be attached to the short end of each glass tube. The tube may be now sucked by the mouth till the fluid in the bottle begins to flow down the tube. When it runs out, the stop-cock must be turned off. This is done to prevent any air getting ingress to the vessels. That contingency must ever be guarded against as fraught with danger to the success of the operation. We have now two tubes filled with the fluid, and constituting a column whose weight is sufficient to overcome the resistance of the vessels. Now commence operations at the heart ; but before doing so sundry accessory appliances should be provided. A nozzle should be selected as near the size of the *aorta* as possible. The nozzles have two pro-

jecting spurs, the use of which we shall see presently. A ligature needle should be constructed as follows: Flatten the end of a stout piece of copper wire and having drilled a hole in it, polish the end very smooth, and fix it in a wooden handle. Have ready some fine twine or stout thread; now insert the nozzle into the left ventricle, having previously filled it with the salt solution. When the tube has passed within the arch of the *aorta*, put the ligature needle, threaded, under the vessel; draw the thread through and remove the needle, and tie the tip of the nozzle in the vessel and fasten the ligature to the spurs before mentioned. This prevents the nozzle from slipping out of position. Now insert the stop-cock belonging to the salt solution into the nozzle, taking care that no air gets between, and turn the cap, when the diminishing depth of the solution in the bottle will tell whether it is flowing through the vessels to wash them out. When sufficient has flowed through, it is only necessary to transfer the stop-cock to the blue injection, when, if all things have gone well, the exposed tissues will almost immediately become colored. This flow may be left uninterrupted for such a time as may be deemed enough to permit the capillary system to be thoroughly permeated. This plan answers equally well for the carmine gelatine injection; only everything must be kept warm to prevent the gelatine setting. Some prefer this plan to that of the syringe, as the constant renewal of the fluid with this tends to rupture the vessel. Another objection arises from the fatigue to the hand in keeping up a constant and steady pressure during the process. In this plan the nozzle being fixed once and for all, and without any strain, no such danger as a rupture presents itself, while the steady flow of a five-feet column of fluid is sufficient without hand pressure. There are methods given in books by which insects, mollusca, etc., may be injected.

A few words in reference to the mounting of injections. The medium for mounting, in most cases, is Canada balsam, and although this is easy of application, it robs an injected preparation of half its beauty, and nearly all of its instructiveness. We see an exquisite network of vessels, but look in vain for those important parts which the vessels are there to nourish; these are blotted out and obliterated by the balsam. The mountant, therefore, should be one which allows the relations of vessels to their immediate substructure to be clearly seen and studied. Such a medium as glycerine solution of varying density should be chosen, that solution being selected which shows these relations the best. The mucous coats of the stomach and intestines, however beautifully and completely injected, lose half their value as instructive agents when their glandular and villous elements are stamped out.

[*To be continued.*]

CORRESPONDENCE.

The lenses of Carl Reichert are making a stir. His former 1–15th now, and truly a 1-12th, oil immersion of 1.25 numerical aperture is in my possession, and in my judgment, as well as that of Dr. Stokes, is a very superior lens. Well corrected, resolves *A. pellucida* "easily and well" (Stokes); *long* working distance (about 1-50th inch); beautiful definition, "wonderful capacity of light" (Stokes). Price, $22; with duty paid, $35. Quality on a plane with Powell, and Leland, and Spencer.—*Edward Gray*, *Benicia*, *Cal.*

Protective Inoculations.

By B. MEADE BOLTON, M. D.,

BROOKLYN, N. Y.

[From *Brooklyn Medical Journal*, June-September, 1890.]

[*Continued from November, 1890, page 255.*]

It is apparent, therefore, that the question of the practicability of protective inoculation for animals is not yet settled. Protective inoculation in human beings has been less studied than inoculations in animals from the nature of the case. Among the first experiments under the former head come Fehleisen's inoculations with cultures of the streptococcus of erysipelas for the production of erysipelas, with a view to arresting the growth and causing the disappearance of malignant growths. These inoculations differ in principle from all the inoculations mentioned above, in that their object is to produce, secondarily, an entirely different disease, which, in some cases, is found to supplant the more severe primary affection. Fehleisen was justified in these experiments by the clinical observation that malignant growths sometimes disappear if the patient acquires an attack of erysipelas. Fehleisen's results were encouraging. The artificial production of erysipelas in the way above described has been repeatedly tried of late years, and often with the best therapeutic effect. Persons who have recently had an attack of erysipelas are not susceptible to the disease by inoculation. This method of preventing and curing a disease by inoculating cultures of micro-organisms of other diseases has been tried to a considerable extent upon animals; but it has been restricted as yet to laboratory experiments, and has not been tried practically upon the large scale for the prevention or cure of natural outbreaks. The starting point for these experiments was Emmerich's observation that animals inoculated with virulent cultures of anthrax bacilli, and either simultaneously, immediately before, or directly afterward, in the same spot with cultures of erysipelas streptococci, did not die. Pawlowsky, in consequence of this observation, made a large number of experiments upon animals. He inoculated with cultures of anthrax various other organisms together. He found that local malignant pustule in animals could be prevented by inoculating into the seat of disease several different kinds of micro-organisms; but he got the most uniform results by injecting Friedlander's so-called pneumonia bacilli either simultaneously with or subsequent to the inoculation with anthrax. Inoculations with cultures of pus staphylococci and anthrax give similar results. Inoculations of cultures of bacillus prodigiosus, after inoculations with cultures of the anthrax bacillus, also prevented the latter from producing the disease, though not so uniformly. Where cultures of anthrax bacilli were injected into a vein, the Friedlander's bacillus was the only one which had any effect in arresting the appearance of anthrax, and this was successful only in rare cases.

The protective inoculations for hydrophobia have attracted more interest by far than any other efforts in this direction. For the benefit of those who are not familiar with the fundamental principle and gradual development of these inoculations, the following *résumé* of Baumgarten (Jahresbericht ü. d. Fortschr. i. d. Lehre v. d. path. Mikro., etc., Brauschweig, 1887) may be of use: "After Brown-Séquard and Duboué had already made it appear very probable that the main seat of disease in hydrophobia is in the central nervous system, Pasteur es-

tablished positively that the hydrophobia poison is, at least in the most concentrated form, if not exclusively, in the above-named tissues. Pasteur, moreover, found that the surest way to transfer the disease is by means of subdural application of cerebral substance of animals suffering with hydrophobia, while the subcutaneous transfers are less sure. Almost without exception the animals inoculated under the dura with small amounts of the above-named substance died of raving hydrophobia, after a period of incubation of from fourteen to twenty-one days. In general, the smaller the amount of the substance inoculated, the longer the period of incubation. Pasteur then found that the passage of hydrophobia poison through the bodies of apes weakens the virulence, while the passage through the bodies of rabbits increases the virulence. By inoculation from rabbit to rabbit through forty or fifty generations (individuals), Pasteur obtained a 'virus fixé' with exactly seven days' period of incubation, which differs from the ordinary so-called 'street hydrophobia,' not only in this short period of incubation, but also from the fact that subcutaneous inoculations, as well as subdural, produce fatal hydrophobia *without exception*. By successive passage of the virus which had been attenuated in the body of an ape through rabbits, Pasteur obtained a series of hydrophobia material for inoculation of graded virulence which he used as vaccines in dogs. He believed these vaccines rendered dogs immune from the poison of street hydrophobia, according to the results of his experiments in this direction. Later on Pasteur used another method of attenuation and inoculation, which seemed so trustworthy, and at the same time so free from danger, that he held that he was justified in risking its use on man. He used it on a large scale on persons who were bitten by animals which were either mad or supposed to be so, and this example of Pasteur's was imitated, as is well as known, in different countries. The process referred to rests upon Pasteur's discovering that the substance of the spinal cord of animals which have died of hydrophobia loses its virulence gradually from day to day if it is dried out, at a constant temperature of 20° C., over anhydrous potassium hydrate. In sixteen to eighteen days the substance so treated loses its virulence entirely, and the subcutaneous inoculation of dogs with the weaker virus (dried for a longer time) protects them from the effects of the stronger virus (dried for a shorter time), and so are finally protected against the poison of street hydrophobia; moreover, differing from the results of all other methods of protective inoculation, not only protecting against subsequent infection, but also against the infection which had already taken place.

[*To be continued.*]

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Acknowledgments.—We beg to acknowledge the receipt of, and also to thank the donor for, the following beautiful photo-micrographs: Group of Diatoms from St. Peter's, Hungary; Pathogenic Bacteria of Bacilli of Typhoid Fever, magnified 2,700 diameters; Saprophytic Bacteria of large Spirillum found in sewage water (this object taken by lamp-light with a Spencer $\frac{1}{10}$ at a power of 2,000 diameters); Plate culture of Bacilli Anthracis, magnified 700 diameters, showing spores. These are all the work of J. E. Baker, M. D., of Wyoming, Ohio, and are excellently executed.

OBITUARY.

Died, Dec. 11, 1890, of typhoid fever, Jay Lee Smith, of South Orange, N. J., aged 34 years.

In the death of Mr. Smith, the Essex Co. Micros. Soc. of N. J. has lost one of its most valuable members, and the microscopical fraternity a genius in the manipulation of the instrument whose superior it will be difficult to find.

Possessed of means sufficient to satisfy almost any desire, and being a lover of nature, he devoted a great part of his time to the study of the little things which surround us in field and brook, and left many evidences of his skill in microscopical preparations which others will enjoy for years to come. Generous and noble-hearted as the day is long, he was ready at all times and with enthusiasm to enter into the work of a fellow-student, helping with the means at his command to bring to a successful issue what might otherwise have resulted in failure.

His first systematic work in microscopy was upon the mosquito, and he devoted considerable time to the study of its growth and development. The embryo chick received a great deal of attention from him as many will testify who have been fortunate enough to possess some of his fine slides. In connection with another member of the Essex Co. Soc., he made an exhaustive study of the anatomy of the earth-worm, and prepared a valuable paper upon this subject which was read before the Society in June, 1887.

One feature of Mr. Smith's work, which was apparent to all who observed him, was the extreme delicacy of his manipulation of the microscope, and this, coupled with his knowledge of its possibilities, resulted in making him foremost among those who have been able to utilize to its fullest capacity that beautiful instrument.

MICROSCOPICAL SOCIETIES.

St. Louis Club of Microscopists.—Frank Davis, *Sec'y.*

December, 1890.—Dr. H. M. Whelpley read a paper containing notes on the chigger, *leptus irritans*.

It is no relation to the *pulex penetrans* of South America and the West Indies. The latter insect is variously known as the chigger, jigger, chiga, chigoe, chique, chic, chics, etc. It is a small insect of the flea family (*pulexæ*), while the *leptus irritans* resembles the tick family (*ixodidæ*). The application of the name chigger to both animals has caused some who are familiar with the South American insect, but not the North American one, to suppose that I was in error when giving the *leptus irritans* the vulgar name of "chigger." As this is the most common name for the animal, I was obliged to accept it.

I have also found another common name for the insect, as in some localities it is known as the sea-tick.

This pest to human beings is not confined to as small a section of the United States as my first investigations indicated. The Eastern and Southern States share with the Mississippi Valley in harboring it. I

have not heard of it in latitudes north of the fortieth degree, nor does it seem to thrive in the far West.

Many correspondents have confirmed my statement that chiggers are partial to blackberry bushes. Attention has also been called to the fact that the insects have a special liking for peach trees.

The chigger does not confine itself to a strictly human diet, but attacks the house fly (*musca domestica*). I have not personally observed the parasite on flies, but Dr. G. De Von informs me that he has. He thus accounts for the transportation of chiggers to infants that do not come in contact with living vegetation.

Dr. J. T. Whitlock finds that chiggers are also very troublesome to young fowls, especially small chickens. He has observed the parasites collected in lumps as large as the head of a pin, and has seen as many as a dozen such lumps on one chicken not two weeks old. He further states that in such cases the chick generally dies promptly, with all the symptoms of poisoning by strychnine. He reports the case of a chick dying after a number of tetanic spasms, lasting for perhaps an hour.

There is a great difference in the degree of susceptibility of different persons to these parasites. Several persons have assured me that they are never attacked by chiggers, bed-bugs, fleas, or ticks. On the other hand, one of the most prominent microscopists of this age writes that his daughter is so severely afflicted by chiggers that she has been confined to her bed for several days.

Some specimens of the insect are almost transparent, but they all become darker in color as they engorge with blood.

I find that both keresene and spirit of camphor are extensively employed to prevent the attacks of the parasite, and to cure sores when formed.

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San Francisco Microscopical Society.—W. E. Loy, *Sec'y.*

Wednesday, December 3, 1891.—In the absence of the President, Vice-President J. G. Clark occupied the chair. The Secretary reported the usual accessions of scientific periodicals, and as donations a volume on "Disinfectants," prepared for the National Board of Health by Dr. Sternberg (donated by the author), and a valuable report made to the Secretary of Agriculture on "The Parasites of Sheep," by Dr. Cooper Curtice, connected with the Bureau of Animal Industry.

There being no regular paper before the society, Charles W. Smiley, editor and proprietor of the *American Monthly Microscopical Journal*, Washington, addressed the meeting, giving an account of the various scientific bodies in Washington, and mentioning incidentally the work being done by the different specialists in or near that city. He maintained that the most important invention in aid of microscopical research, after the instrument itself, was the microtome. By its aid students in animal and vegetable histology were enabled to make a comparative study of tissues not possible without it. He thought the next most desirable aid would be a rapid and cheap method of mounting sections, so that the student could quickly prepare an entire series of sections. Mr. Smiley also spoke of the periodical literature of the microscope, as developed in the United States, and regretted that with a population of 62,000,000 an edition of 1,500 copies served those inter-

ested in that instrument. It was a matter greatly to be regretted that one comprehensive, ably-edited journal like the *Journal of the Royal Microscopical Society* of London could not be maintained in this country. It had been suggested in the East to incorporate the two monthly journals in the United States with the proceedings of the American Society of Microscopists and endeavor to issue one creditable periodical, but no plan has yet been matured by which the end could be attained.

The Vice-President, on behalf of the society, thanked Mr. Smiley for his remarks, which were timely and to the point.

NOTICES OF BOOKS.

Die Mikrophotographie als Hilfsmittel naturwissenschaftlicher Forschung, Von Gottlieb Marktanner-Turneretscher. Halle, A. S., Wilhelm Knapp. 1890. Pp. 344, with two plates.

The title of this excellent work expresses its comprehensive scope as well as its general character. The author is better known in Vienna perhaps than to the microscopists and photographers of the United States, but his ingenious devices for facilitating the operations of photomicrography are not unknown to the readers of this *Journal*. The work before us is largely devoted to the description of apparatus for photomicrography. The illustrations are excellent and well chosen. The literature of the subject is well summarized, and scarcely anything of importance has been omitted. It is a meritorious work, reflecting great credit upon the author, and manifesting his painstaking effort to embody the results of the experience and practice of many successful operators within the pages of a single volume. The different important methods of preparing plates for negatives and paper for prints are well described, as well as the best methods of manipulation for the production of negatives and prints. The excellent apparatus of the author for photographing microscopic objects in motion is not only ingenious but eminently practicable. By means of a reflecting prism the light from the object is reflected into a secondary tube with an eye-piece. By looking down into this tube the field of view can be examined and at the proper moment the light can be instantaneously thrown upon the sensitive plate in the horizontal camera. This device could readily be applied to other forms of apparatus, the important feature being the arrangement for making the instantaneous exposure. The writer of this review saw the original instrument devised and successfully used by the author at his home in Vienna two years ago, and was greatly pleased with it at the time.

Much valuable information is given in the book as a result of the author's long experience, and the work is to be highly recommended as the best and most complete publication on photomicrography we have seen.—*R. H.*

—o—

The Origin of the Aryans. By Isaac Taylor, M. A., Litt. D. The Humboldt Publishing Co., 28 Lafayette Place, New York.

This is an account of the pre-historic ethnology and civilization of Europe.

The last ten years have seen a revolution in the opinion of scholars as to the region in which the Aryan race originated, and theories which not long ago were universally accepted as the well-established conclusions of science now hardly find a defender. The theory of migration from Asia has been displaced by a new theory of origin in Northern Europe. In Germany several works have been devoted to the subject, but this is the first English work which has yet appeared embodying the results recently arrived at by philologists, archæologists, and anthropologists. This volume affords a fresh and highly interesting account of the present state of speculation.

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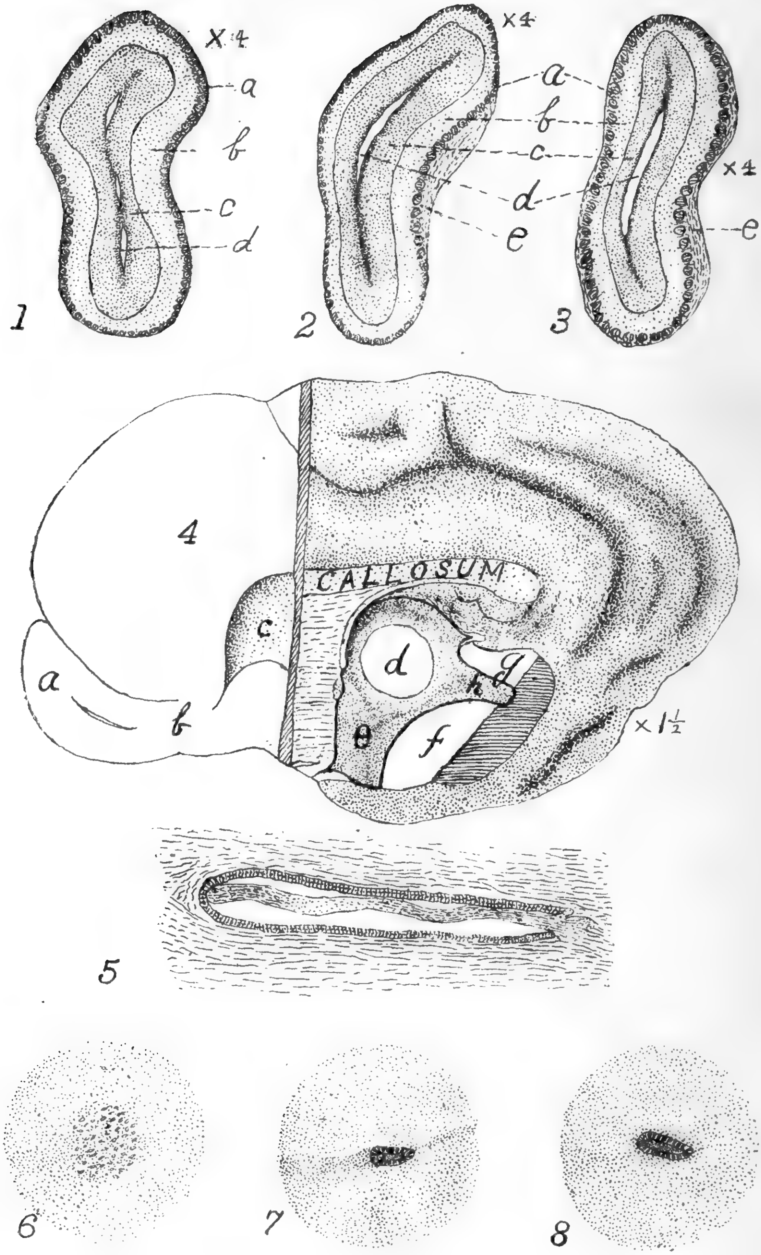

OLFACTORY LOBE IN THE CANIDÆ.

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The Partial Occlusion of the Olfactory Lobe in the Canidæ.

BY PIERRE A. FISH,

ITHACA, N. Y.

[Read at the Boston Meeting of the American Anatomists, 1890.]

[WITH FRONTISPIECE.]

Broca is, perhaps, the only anatomist who has attempted to describe the structure of the dog's olfactory lobe with reference to the occlusion of its cavity. Meynert in his article on the "Brain of Mammals" gives a figure of a canine hemi-cerebrum containing a rhinocœle (olfactory ventricle). Obersteiner in a more recent work on "Central Nervous Organs" gives a similar diagram Huguenin, Owsiannikow, and others in their study of this region in different mammals, including the dog, have never hinted at anything contrary to its existence.

Embryology demonstrates that the olfactory lobes in all mammals are hollow at a certain stage of development, and the persistence of this embryonic feature to an adult stage may easily be verified in the elephant, horse, cow, sheep, pig, rabbit, cat, and probably the majority of quadrupeds. Dogs are proverbially noted for the acuteness of their sense of smell; but it is doubtful if it is due to the partial occlusion of this cavity.

In Broca's classification, those mammals, especially the carnivora, in which smell is highly developed, are osmatic; those in which it is poorly developed are anosmatic, and are represented by man, monkeys, and cetacea.

Professor Turner, of Edinburgh, has proposed the more specific terms, macrosmatic for those included in Broca's osmatics, microsmatic represented by man and monkeys, and anosmatic represented by the dolphin, in which the olfactory lobes are said to be absent.

The dog in this classification seems to hold an anomalous position,

in that he gives every external evidence of macrosmatic power; but by the almost total occlusion of his rhinocœle approaches structurally the conditions found in the microsmatics. *Physiologically* he is macrosmatic; *morphologically* he is microsmatic.

Broca's studies were limited to the *ratiers* (rat-terriers). He thinks, however, that perhaps the cavity exists in other races of dogs. In some cases he found an "apparent cavity," which he ascribed to the tearing of the tissue by the knife used in cutting; at other times there remained a wider cavity "whose interpretation is doubtful." His specimens were placed immediately into absolute alcohol for hardening. This he deemed of especial importance since the substance forming his so-called ventricular axis decomposed very rapidly, and after a few hours lost its consistence, so that when sections were cut a cavity appeared which resembled a true rhinocœle.

In the present investigation, there were used the brains of a rat-terrier, spaniel, and of some half dozen other dogs whose breed was not determined. The results were practically the same in all cases. In addition to the material just mentioned, Professor Wilder very kindly placed in my hands for comparison the olfactory lobe of a coyote, *Canis latrans*, and of a species of a wild Australian dog known as *Canis dingo*.

The cavities of the brains were injected with the preservative in order that the parts might harden uniformly and as nearly as possible in their natural position. There should be no difficulty in detecting the presence of a cavity in this region with a microscope; and, if there is one, an injection would make it very apparent and render assurance doubly sure.

After some experimenting it was found that an alcoholic solution of zinc chloride—95% alcohol, 100 c.c.; zinc chloride, 5 grains—was the most efficient fluid for hardening purposes.

Its action was rapid and even, and produced little or no distortion. Sections hardened in this manner stain readily in either carmine or hæmatoxylin.

A transection of the dog's olfactory bulb at about the middle of its length revealed a very small rhinocœle, whose boundary showed no indication of having been torn by the knife, since the endymal cells still retained their normal appearance. Very rarely did they preserve an unbroken continuity. At one end there was usually an interruption through which was projected a tongue-like extension of neuroglia.

The process of occlusion appears to be the result of the intrusion of the neuroglia into the rhinocœle, accompanied by the gradual growing together of the walls. The lateral diameter being the smaller, the sides come together first; but the width of the cavity is not uniform, and there may exist two or more very small cavities between the points of contact, each surrounded with its endymal cells, except at the point of interruption. At the points of contact, the cells become obliterated, the neuroglia thrusts itself into the cavities, and ultimately fills them more or less completely.

Imbedded in the neuroglia are numerous small granules which take the stain in the same manner as nuclei, but around which no cell-bodies were seen. Small blood-vessels follow these intrusions of the neuroglia and ramify in all directions.

In the crus, as might be expected from the narrow canal-like extension of the rhinocœle, the occlusion first becomes complete. In the now

obliterated canal is an axis which is composed of granules, broken-down endymal cells, and capillaries.

Of the species of wild canidæ examined, the brain of the coyote had been poorly preserved in alcohol, and the olfactory bulb had become somewhat distorted, rendering it undesirable for the study of its structural elements. A small central cavity, however, was easily seen; but the endymal cells, on account of maceration, had probably become disintegrated and finally disappeared. In the crus the cavity had become entirely closed up. The dingo's brain, also preserved in alcohol, was in a much better condition. The cavity of the olfactory bulb was very distinct and relatively large; at certain points a few endymal cells still adhered to its border. The cavity of the crus, however, as in the other specimens, was completely occluded.

In the larger domestic dogs, especially the Shepherd and Newfoundland, the gross appearance of the olfactory lobes resembles very much that of the wild species, on account of the projection of the bulbs beyond the cerebrum. In the terrier and spaniel the increased development of the frontal lobes causes the cerebrum to overlap the bulbs.

A study of embryonic conditions may demonstrate when the process of occlusion begins, and would be a most important auxiliary to our complete understanding of existing facts.

CONCLUSIONS.

1. That facts do not warrant Broca's statement as to the existence of a *true* ventricular axis in the olfactory bulb, even in the rat-terriers.

2. That the bulb is not completely but *partially* occluded, or in process of becoming entirely so.

3. That the cavity of the crus in some wild species, as well as the domestic species, is completely closed, thereby shutting off all communication between the paracœle and the cavity of the bulb.

4. That the acuteness of the sense of smell is not essentially dependent upon the relative size of the rhinocœle.

5. That atrophy is not necessarily a concomitant of occlusion.

6. That domestication and a consequent disuse of olfaction as a means for procuring sustenance *may* be a factor in promoting occlusion.

DESCRIPTION OF PLATE.

Fig. 1. A transection of the dog's olfactory bulb, enlarged four diameters.

a. Glomerular layer.

b. Gelatinous layer.

c. Medullary layer.

d. Rhinocœle divided into three smaller cavities by the growing together of the walls.

The plexiform layer is present in the dog, but is not represented in the diagram. Neither are the ganglionic and granular layers shown.

Fig. 2. A transection of the olfactory bulb of the coyote.

e. Plexiform layer. Other letters as in fig. 1.

Fig. 3. A transection of the olfactory bulb of the dingo.

e. Plexiform layer. Other letters as in fig. 1.

Fig. 4. Hemi-cerebrum of a dog. Enlarged once and a half. The straight lines and unshaded parts represent cut surfaces. The callosum

is a cut surface; the dots represent fibres. The outline of the mesal cavities is indicated by the heavy black line. The specimen was prepared by slicing away the cephalic portion of hemi-cerebrum to a depth of about five millimeters.

a. Olfactory bulb with its small rhinocœle entirely circumscribed.
b. Olfactory crus; its cavity is completely closed.
c. Paracœle (lateral ventricle).
d. Medicom missure.
e. Diacœle (third ventricle).
f. Cerebral crus.
g. Geminum.
h. Mesocœle (aqueduct of Sylvius).

Fig. 5. The rhinocœle of a dog, much enlarged, to show the intrusion of the neuroglia into the cavity, and the break in continuity of the endymal cells.

Fig. 6. A section through the central portion of the olfactory crus of a dog. The darker portion represents the axis, composed of broken-down endymal cells, granules, etc.

Fig. 7. A section through the olfactory crus of the coyote. The endymal cells still remain, but the cavity is entirely occluded.

Fig. 8. A section through the olfactory crus of the dingo. The cells and cavity are as in fig. 6.

A Method of Drawing Microscopic Objects by the Use of Coördinates.

By COOPER CURTICE, D. V. S.,

MORAVIA, N. Y.

[Read before the Washington Microscopical Society, 1891.]

The method which I am to detail is one that I found in use by Dr. George Marx, of the Division of Illustrations, in the U. S. Agricultural Department, when I first engaged in studying animal parasites in 1886, but it was originated some eight years earlier, as he informs me.

It is a method that has such obvious merits that I take pleasure in placing it before students of the microscope, but I present it as a relator of a valuable method rather than of original work. Its simplicity, its cheapness, its accuracy, the ease with which a figure of any magnification or reduction may be made, and the rapidity with which a beginner adapts himself to its use, all serve to recommend it.

A small glass slide, of the size of an eye-piece micrometer, or a disc, ruled into squares, is inserted into the eye-piece, so that the lines seem to rest upon the object. Tracing paper is placed over cardboard ruled into squares. The drawing is then made free-hand, the various points being located in a symmetrical position with respect to the lines underlying the paper that they occupy in the apparently ruled image. The drawing made on the tracing-paper may then be either transferred to drawing-paper without reduction or be reduced by applying the same methods that produced the picture and then be worked up.

Dr. Marx prefers using the slide. It is ruled into squares one millimeter on each side, every third line being slightly deeper to make it more prominent. I prefer for most uses the finder made by Zeiss. It

is a circular disc upon the centre of which are ruled two sets of ten lines, at right angles to each other, the lines being five-tenths millimeter apart. The lines are very neatly ruled and covered by a thin cover-glass cemented to it with balsam.

It is apparent that the system has a wide application so far as the magnifications to be attained are concerned. The equation giving the magnification is:

$$x = \frac{b}{a} \times c.$$

a being the length of object, b the length of image, c the ratio of the image to the drawn figure.

Suppose that the amplification of objective is $5 \times$; that the lines on the eye-piece slide be one-half millimeter apart, and those on the cardboard be 6 millimeters, then $x = 5 \times 6 \times 2$, or 60, for the unit of the card squares are twice those of the eye-piece squares.

To use a series of objectives, or of squares for the eye-piece and for the cardboard are easy matters. A single glass ruled to half millimeters made to fit a low-power eye-piece is sufficient to try the plan. Cardboards, either of Bristol board or heavy-calendered manilla paper, may be ruled into squares 3, 5, or 7 millimeters, etc., until the student has all the combinations desirable.

By adopting this plan of drawing figures, I have found that objections which I find to using the camera are avoided. The lighting is not interfered with, the image moves but little, if any, with the movement of the head, and the image can not be distorted. It is true that the accuracy of the figure depends on the skill of the artist, but a short trial of the method will satisfy most students that the actual variation of the drawing in symmetry from the image is less than that in figures made by the camera.

The objection now existing that American makers have not on hand necessary slides will be gladly removed by them as soon as they see a demand.

Sixteenth Annual Report of the American Postal Microscopical Club.

By R. H. WARD, M. D.,

TROY, N. Y.

[*Continued from page 35.*]

Botany.

Corn Silk and Pollen.—Early in the morning before sunrise pollen was sprinkled upon a silk just protruding from the shuck; after five or six hours the ends of the silk were cut off, put into camphor water, and after several days mounted in the same. By focussing up and down the pollen tubes may be seen. The pollen must be sprinkled on a *fresh* silk early in the morning while it is damp. If no tassel can be found ready to shed its pollen, cut off one and hang it in the sun: in half an hour or more it will fall copiously. In four or five hours hundreds of tubes will be found penetrating each silk. If the silk thus specially fertilized be mounted in some suitable medium (water will answer) and

examined, many of the grains may be seen in the act of discharging their contents. I have never been able to ascertain exactly how far the tube penetrates the stigma, but not more, I think, than a millimeter or two. The protoplasm after leaving the pollen tube, by pressure from behind and capillary attraction, passes rapidly to the ovary. It passes out in a constant stream and takes about fifteen minutes to empty the grain.—*J. M. Barrow.*

Petrified Wood.—Dr. Sylvester's beautiful section of a rose stem, showing the ducts so well, has prompted me to make a mount of a coniferous or gymnospermous fossil wood; in which order with the peculiar medullary rays, and the pitted structure, the absence of all ducts is characteristic. Fossil or petrified wood usually has to be sliced by grinding in order to get a section for the microscope. Happily in this unique instance nature has furnished us with casts in pure silica of every organism of the plant in absolute *fac simile*, and exquisite sharpness of detail. Here there is no injurious flattening, as occurs in a ground or sliced section. The pitted cell or structure stands out in all its lenticular rotundity. In some parts of the slide these may be seen shelled out, as peas from the pod, leaving a clean circular cavity in which each had fitted. The medullary rays are also shown with their smaller and somewhat elongate pitted markings, but nowhere is any duct seen. The specimen is from a large piece of a fossil tree stem obtained in clipping at Asbury Park, N. J. It is a conifer, and I should identify it as the fossil genus *Cupressinoxylon*. I regard it as a *tertiary* fossil, but there is doubt as to its exact geological position. The plant is found fossil in Greenland as well as in New Jersey. Of the Greenland flora, I only know of one plant that has survived in our State, and that is a fern.—*Samuel Lockwood.*

Diatoms from an Artesian Well.—The fossil marine diatoms on this slide were found in the material taken from an artesian well at Atlantic City during last year at the depth of 610 feet from the surface. The diatom bed was found to be 300 feet in thickness, and it was first reached at a depth of 400 feet from the surface. So that, estimating the great lapse of time required to form the deposit on the bottom of the ocean at twenty years for each inch (which is considered a moderate average of advance of time among naturalists), we then have 240 years for each foot and the enormous period of 72,000 years for the total deposit of 300 feet; and then, in addition to the above period, it will be necessary to approximate the time required to form the 400 feet of non-diatomaceous material which overlies the 300 feet of fossil diatoms.—*Henry Berger.*

Diatoms.—Fresh-water diatoms from coherent but friable peaty material, dark colored, with a grayish hue; consisting of vegetable matter, sand, and diatoms, found at Northboro', Mass., lying directly upon a glacial deposit and associated with the remains of a mastodon. The original material came from Prof. F. W. Putnam, who gave the above details of locality to Fred. K. LeRoy Sargent in 1886, from whom the present contributor received it in 1889.

Mr. C. Henry Kain, to whom I am indebted for a list of the species, says the forms are those which are common in several places in New England in peat formations, and also living in fresh water lakes and streams, and that their chief interest is on account of their association with the remains of the mastodon.—*Chas. W. Swan, M. D.*

Practical Microscopy.

Bacillus of Tubercular Consumption.—This slide was mounted Dec. 20, 1889, from a cheesy mass about as large as a flax seed, found in the expectoration of a patient in the last stages of pulmonary phthisis. The sputum was spread out upon a fragment of clean window glass about three or four inches square, and held up to the light where the millet-seed-shaped cheesy masses could be easily seen. * * *

The slide showed the bacilli very distinctly, both as solid rods and as chains of spores. Near the edge of the cover, fields can be shown containing hundreds of thousands of bacilli of various shapes and sizes. A very interesting fact connected with the case of this patient is that the general mass of sputum, exclusive of the cheesy masses above referred to, contained scarcely any bacilli. The patient had been treated for more than a year for bronchitis. The slide has an additional interest from this fact that it is one of the slides presented by the writer for examination to Gov. Fifer, of Illinois, while making an effort to obtain the pardon of this patient who was confined at the Southern Illinois Penitentiary (sentenced for a term of 12 years for forgery), and which he believes was partly instrumental in securing the pardon, which was granted a few weeks later. The patient died in a St. Louis Hospital a few weeks after the granting of the pardon. Therefore in addition to its other numerous practical uses, the microscope was, the writer believes, successfully used in this case in the cause of humanity.—*James A. Close, M. D.*

Adulterated Ground Pepper.—Of all the spices, black pepper seems to be the most subject to adulterations. Of the numerous samples I have examined I have found nearly three-fourths more or less adulterated. The fact that ground pepper can be bought cheaper than the whole grain goes to show that something must be "rotten in Denmark." The most common adulterations I found were ground crackers, beans, and shells of all sorts. The use of potato starch (as in this sample) for the purpose of sophisticating this spice, is comparatively rare. Battershall does not mention it in this connection at all; Hassell, however, does. This sample was obtained in New York city during the winter of 1881, and it showed a much larger per cent. of potato starch than this particular mount does; as it seemed almost impossible to prevent the loss of some of the starch when adding the balsam to complete the mount. The starch will be found much more readily with the aid of the polariscope when the beautiful cross of this starch will show up very plainly.

In this connection I would say that we ought to agitate as much as possible for a national adulteration law. State laws for various reasons are dead letters; and moreover any State not very strict in their enforcement becomes the dumping ground for all the adulterated stuff from States more vigilant. The amount we are annually out of pocket (to say nothing of really dangerous admixtures, and especially of diluted medicines, etc.) from this source alone must be enormous.—*F. T. Aschman.*

Silk Fibre from U. S. Bank Note.—This is a portion of a Treasury note from which the silk fibre has been removed. The fibre is shown at the right. This fibre is woven into the paper during the pro-

cess of making. The method of doing this is a secret zealously guarded by the manufacturers and the Government. Its purpose is to prevent counterfeiting. Formerly the fibre was scattered in small fragments irregularly through the paper and was easily imitated by exterior marks. The present method insures a continuous line, generally two, of silk fibre running parallel with the length of the note and so woven into the paper as to leave it visible from either side, and yet far enough from the surface to retain its identifying property so long as the note is in circulation. The object is sent as a means of information, the contributor finding many people unfamiliar with this means of identifying counterfeit money. It was adopted by the U. S. Government in 1885.—*Wm. J. Morrison.*

TECHNIQUE.

Sections of Staminate Cone of Scotch Pine.—Contributed from the Botanical Laboratory of the University of Nebraska to show what can be done by the paraffine imbedding process in cutting and mounting objects which otherwise would fall to pieces. The preparation was as follows in detail:

The cone was first put into 35 per cent. alcohol for 12 hours. Then successively 12 hours each in 50 per cent. alcohol, 75 per cent. alcohol, hematoxylon, 90 per cent. alcohol, absolute alcohol, alcohol and turpentine, pure turpentine, cold paraffine and turpentine. It was then put into warm paraffine and turpentine for 6 hours, then into melted paraffine (50° to 55°) for 6 hours; it was then imbedded in the paraffine and cut into ribbons upon a Reichert Thomé microtome, the sections being 20μ ($\frac{1}{250}$ inch) thick. The ribbons were fixed on the slide with white of egg and glycerine. The slide was warmed to melt the paraffine, which was then washed away with turpentine, washed next with absolute alcohol, then 90 per cent. alcohol, then water (distilled), then stained with fuchsin about two seconds, next washed with distilled water, 90 per cent. alcohol, absolute alcohol and turpentine in succession. Canada balsam in chloroform was then poured over the specimen and the cover-glass laid on. I have given every step taken in the operation. The hematoxylon did not penetrate, hence the staining by fuchsin was necessary.—*Charles E. Bessey.*

Longitudinal Sections of Head of Blossoms of Marigold.—Sent around as an illustration of the paraffine imbedding of vegetable structure. Two ribbons of sections are on the slide. The method of fixing the sections on the slide was as follows: (*a*) Slide was coated with collodion by flowing as in wet plate photography; (*b*) after the ribbon of sections was put in place it was wet by means of a delicate brush with a solution of alcohol and ether, which softened the collodion and caused the sections to settle down into the film, and the rapid evaporation of the solution left them securely fastened; (*c*) the paraffine being next melted over a lamp, the slide was flooded with turpentine; (*d*) after which Canada balsam and the cover followed.—*T. D. Biscoe.*

Mounting Moulds.—Nearly all the mucedines or moulds, so beautiful in nature and tempting to the microscopist, are very shy of handling for preservation. This specimen illustrates about the average degree of success which I attain by the following method: A young plant was selected, laid upon a slide and covered with a bit of thin glass; just

weight enough to hold it in position. Then alcohol 95 per cent. was allowed to run between the glasses, followed by pure glycerine (carbolated). When the eddying currents had all ceased, more glycerine was added to float off the cover. The plant was then transferred to a cell by means of a thin spatula (of horn), a glass let down, and "clipped," and half an hour later washed freely and a ring of cement added.

The cement was prepared as follows: Bleached lac was dissolved in alcohol 95 per cent. and made quite thin, allowed to settle, and the clear amber liquor decanted and then allowed to evaporate down to proper consistence to flow freely. To each ounce of the thick solution three or four minims of castor oil and one or two of oil of lavender were added (this latter *chiefly* for perfume). This cement I keep as one of my standards and commend it after a use of nearly fifteen years. Of course it can be colored "to suit the taste." The present specimen has been mounted about two years.—*L. Brewer Hall.*

Corn Smut.—This slide was prepared from spores of corn smut collected the previous season, cultivated in a moist chamber as follows: Take a piece of blotting-paper an inch square, cut a ⅝-inch hole in it, wet with water and place on a piece of glass; then take a ¾-inch cover-glass, breathe gently on it, and dust a few of the spores on it, place it over the opening in blotting-paper with spores on the under side; cover with a bell-glass to keep out dust. In a few days the spores will germinate, and can be kept in a growing condition by now and then moistening the blotting-paper. Many interesting slides can be prepared from the spores of various fungi in this simple way.—*E. L. Cheeseman.*

Mounting Copepoda.—Cements and varnishes should be applied in several successive thin coats rather than in one thick one; in this way the varnish will not spread. These specimens should have been placed in distilled water when yet alive, in order that they might become free from the dirt adhering to them and contained within the alimentary canal. When clean they may be dropped alive in carbolic acid, which will render them transparent, and as it does not destroy any of the tissues we can study not only the outer covering but the internal organs as well. Insects dropped alive into carbolic acid become nicely extended before they die. To mount, remove excess of acid and cover with chloroform balsam. This method is suitable for all small insects that are not too dark.—*H. M. Lyon.*

The Potash Method is good enough for large opaque bugs; but for pediculi and such small and transparent insects the following is better: Take a slide with a shallow varnish or other cell, place a drop of Tarrant's solution (gum and glycerine) in the centre, drop the living vermin in the fluid. It will struggle and straighten itself out and die, and soon become transparent enough to show up all its important internal organs, muscles, and tracheæ. A ring of cement to seal the cover down finishes the slide. One then has a mount of a whole insect, worth study; not simply an empty skin flattened out of shape.—*S. G. Shanks.*

Better kill and render transparent in carbolic acid, and mount in balsam. This has at least been my experience.—*H. M. L.*

Carbolic Acid Mounting.—The fly was decapitated after immersion for a few minutes in carbolic acid (pure crystals liquefied by heat). The separated head was covered by a drop of balsam in turpentine and alcohol and a cover applied, completing the mount in from three to

five minutes after the capture of the fly. Try this method for *small* soft-bodied insects.—*C. M. Vorce.*

Carbolic Acid, liquefied by alcohol (or even benzole), will color but comparatively little on exposure to light. Some so treated in Dec., 1888, is now (May, 1890) only turned a little, being a light, clear amber tint and well fitted for preparing insect specimens.—*F. T. Chapman.*

Water-washed Diatoms.—About 1882 Dr. Henry Froeling advised me to try water washing for diatoms, as he had found very clean ones in his still after he had used it many days in making distilled water for his laboratory. I have used it for eight years with perfect success. When I first used it I was corresponding with W. S. McNeill, of Mobile, and advised him to try it, and gave him eight pages of directions; and he turned out the first water-washed Mobile diatoms. Several years afterwards Dr. Taylor came forward with his washings, of which I have never yet seen any that could be called perfectly washed. Mr. Michels says that Dr. T. takes ten hours of continuous work. I can show him *clean* washings that took thirty days; and I think it doing fast work if I finish a deposit in six days. I shall be pleased to hear from any one interested in diatoms, as I have a very large collection, including vials of really clean water-washed collections from various localities.—*Thomas Christian, Richmond, Va.*

Cardboard Slides.—I send this slide upon its travels that the members of the Club may see an easy, quick, and inexpensive mode of using portions of leaves, samples of silk, cloth, or other materials that can be examined on both sides. Cardboard slips, 3 x 1 inch, are punched through the centres, and two of them fastened together with the flat object between them so as to close the central opening of the slides.

One has only to reverse this slide to quickly look on both sides of the leaf. These pasteboards are procurable at the stationers, and can be thicker or thinner or of different colors than this one. Also one can glue these pieces together so as to form a deep well; then cover-glasses can be glued over each side of this well after you have put in sand, flower seeds, or any object requiring a deep setting. Also one may use these slips for mounts for polariscope, as a cover-glass on each side will keep in the balsam used in the mounting. For use in classes when slides are passed from hand to hand these are useful, being easily and quickly made; not breakable, not costly. I see no reason why these slides should spoil by mould, mildew, or moisture if they are properly cared for.—*J. Frank Brown.*

Polished Graphic Granite.—I ground one side of the piece on a lead plate with No. 150 Wellington Mills emery. Smoothed on a Craigleith stone, using water, and powdered Hindostan oil-stone to prevent the Craigleith stone glazing. Afterward used the whetstone without the powered oil-stone. This surface was washed with oil of turpentine and cemented with hardened balsam to this slide. A thin slice about $\frac{1}{50}$ of an inch thick was cut, which remained attached to the slide. This last surface was ground and smoothed in the same manner as the first; washed with oil of turpentine and mounted in Canada balsam. The oil-stone is easily powdered, cuts sharp, and does not scratch even if the stone is not reduced to a perfectly even, fine powder.

The powder was made to pass through a silk bolting cloth. It took about half an hour to powder and sift a pound.—*Norman N. Mason.*

"Flower-Crystals" of Sugar.—This slide is prepared in accordance with instructions given by L. A. Willson, Cleveland, Ohio, in the July, '90, number of *The Observer.*

Prepare two test tubes of saturated solutions of sugar; one of alcohol, the other of water. Then mix the two solutions in a third test tube, and when thoroughly mixed, place a drop in the centre of a slide and let it rest until it becomes a hard homogeneous mass. Then place the slide, thus prepared, on the top of a student's-lamp shade. In the course of a short time the flower crystals begin to develop. Leave the slide in that position until crystals have developed over the whole mass. The crystals are now very hard and permanent, and may be mounted. —*E. F. Bigelow.*

Cells and Cements.—Such objects as this fungus, or indeed any dry-mounted objects, when designed for paraboloid or similar illumination, should be mounted in a cell of some solid substance. Never use rings of wax, nor any cement like zinc white, asphalt, or gold size for cells in dry mounting, and especially shun their use for all but the very shallowest cells in any mounting. For thin cells use tin-foil or lead-foil; for thicker use sheet lead, brass, copper, or celluloid; for deep cells use bone, hard rubber, or brass rings. Cement the cells to the slip with good, hard cement. When thoroughly dry spin a thin coat of a quick-drying finish on the inside of the cell to cover its junction with the slip. When the last is completely dry mount the object, using but little cement between the cover and cell. After long drying, spin finishing cement on the outside of cell to cover junction of slide, cell, and cover. When that is thoroughly dry, the mount is complete; and it will be permanent, free from "sweating," and will never be troubled with "running in" of the cement.—*C. M. Vorce.*

White Zinc Cement.—The same old story. It is said that it won't run; if it don't, then it is because it has been appropriately thrown out of the window. It has run in, in several of these slides.—
* * *

Sections too thick. White zinc would not have run under if cells had been properly made.—* * *

More abuse of white zinc by careless and unskilful workers, who blame the cement for their own lack of skill. I have several slides which have been in my possession fifteen years (I don't know how old they were when I got them) and used hard, which are just as sound as the day they were finished. In the present case the slides were probably mounted in haste before the cells were ready. They have also had four years' travel and usage.—* * *

The running in of white zinc and other cement is often due to the surface of the glass, or to imperfect cleaning. I have mounted eight or ten slides at the same time, of the same object, in same medium, and in same manner in all respects; and had perhaps one of the lot spoiled by running in of cement and all the others stand perfectly for many years. Some slips are slightly rough, some are striated, etc., and although they may be clean the adhesion is not so perfect as to a smooth surface. I think, however, more running in is caused by imperfect cleaning of the slips. Sulphuric acid and bichromate of potash are very cheap, and it

will pay to clean all slips by the chemical instead of mechanical method. A good quality of cement is also essential to success.—*C. M. V.*

MISCELLANEOUS.

Marine Alga (*Ptilota plumosa*).—This preparation in balsam shows the object very much as a well-preserved mummy shows the original. If softened and washed in sea-water, and mounted in hard glycerine jelly, it would show the object as it is in life, with perhaps the loss of a little color.—*J. D. K.*

How to Look at It.—A nice slide; but it would be better if we were told whether to use a three, two, or one-inch objective, and also whether by dark field illumination or otherwise. Full descriptions add greatly to the interest of any slide.—*J. F. B.*

Aniline green that will stand dehydrating with oil of cloves, etc., I do not believe can be found; but I would like to have some one tell me why so many insist on mounting wood sections in balsam. Balsam mummifies everything, while a properly made glycerine jelly preserves protoplasm and differentiates perfectly.—*J. D. K.*

Alcohol.—From the appearance of the mount I should say that the alcohol used for dehydrating was of too low a grade, and that a precipitation has occurred. This is liable to happen with all the olio-resins. If the water is present in a large degree we shall have instead of a precipitation of resin an emulsion of the oil and resin.—*H. M. L.*

Staining.—This specimen should have been double stained after the section was cut As it now is, it merely shows the blood-vessels. Staining would have brought out the cells of the urinary tubes, and in connection with the injected blood-vessels have made not only an interesting but an unusually instructive specimen; for, being a complete section, all of the structural elements are contained in it.—*H. M. L.*

Fading.—This slide (desmids, etc., in glycerine) is over a year old and much faded. It would have been a fine slide if the color could have been held in it. Eosin would have done it, but it might have made a very dark slide.— * * *

Fancy rings do not add anything to the value of the mount; instead, the cover should have been secured by a heavy ring of some tough cement. When the cover is attached by balsam alone, a slight jar is often sufficient to detach it; especially is it so in a case of this kind when the slide is being constantly knocked about in the mails.—*H. M. L.*

Unground edges should not be put in Club boxes (nor used at all) unless the slip is covered with paper. Careless packing of the slides has planed off the cement from some of the other mounts by means of the sharp-cut edge of this slide.—*C. M. V.*

Crushing.—Before mounting the contributor should have cemented three small pieces of cover-glass on the under side of the cover. This would have obviated all the crushing of choice forms so noticeable in this otherwise good slide. Diatoms are also often crushed by the contraction of the balsam after mounting.— * * *

No Cell.—This slide is mounted without a cell excepting what is built up around the cover; therefore it will not bear throwing around a great deal, but it will smile on you if you treat it kindly.— * * *

Cements.—I would like to suggest to * * * that he discard home-made cements, and obtain one or two bottles of King's micro-

scopical cement, and use a turn-table, when he will be surprised at the result obtained.—*W. H. S.*

Mechanical Finger.—These are handsome specimens, and if a few of the perfect forms had been selected by this means and neatly arranged it would greatly have enhanced the value of the mount.—* * *

Surface Gatherings.—This slide is rather a startling one for users of * * * lake ice, which has a great reputation for purity.

Wax Cell.—This slide (diatoms in wax cell fastened with rubber cement) came to me with cover-glass off and loose in the case. I have put on a new cover.

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Microscopy for Amateurs.

BY T. CHARTERS WHITE,

QUEKETT CLUB.

[*Continued from page 42.*]

Diatom Mounting.—No branch of microscopical study possesses greater charms than the study of the diatomaceæ. The insatiable appetite of the diatomist grows by what it feeds upon, and luckily there is no stint, for this class of miscroscopical life is universal in its distribution. It may be met with recent as well as fossil, in fresh water as well as in the sea; there is scarcely a spot in nature where it cannot be found.

Diatoms may be obtained all the year round, but are most plentiful in the spring and summer. Each kind has its favorite habitat; some on the algæ in the sea and on its shore; others have to be searched for in the muddy crevices of the rock. One variety, the *melosira*, is common in marshes, where they may be recognized as brownish masses. Others may be sought for on the surface of mud. Oyster beds are very productive of diatoms, and the stomachs of these succulent bivalves abound in many varieties. Diatoms are so ubiquitous that he who is bent upon making a collection need never be at a loss for material. In examining ponds, especially in marshes, where the water is brackish, a most abundant gathering may be made, as many as forty-three varieties having been identified in one depth. They are generally found floating on the water as yellowish brown masses, or lying on the surface of the mud. In sunshiny weather they may be found floating, because, like other vegetables, they give off oxygen in sunlight, which floats them to the surface; and, should a breeze blow over the surface of the pond, this raft of diatoms may be driven to leeward, where they may be gathered tolerably free from mud and other impurities. The instrument used to collect them may be anything of a spoon shape, such an one as resembles a housemaid's dust-pan in miniature, broad and shallow in front and deep behind. This, attached to a long handle, may be

gently slid under the edge of the raft, which will then float into the deeper end, thence transfer it to a collecting bottle, and label it with the locality in which the collection was made. Such an instrument will also be found of great use in skimming the surface of mud where diatoms are suspected. Having made the collection, one of the most troublesome operations is that of freeing the diatoms from impurities. If they adhere to fresh-water plants or to marine algæ, and are free from mud, rinsing them off in water, to which a small quantity of hydrochloric or acetic acid has been added, will detach them in a tolerably clean condition; but where they are mixed with mud and other contaminations nothing but repeated washings and decantings will separate them. Dr. H. Munro says: "I first boil the deposit in strong hydrochloric acid for five or ten minutes, allow it to subside, pour off all the acid, and by a few washings get as much of it away as possible. Then treat in the same way with strong nitric acid, washing the deposit repeatedy to get rid of the remaining acid. When this is done, I then separate the diatoms, according to their different gravities, by allowing them to pass through a column of water in the following manner: I take a long glass-tube, about four feet long and half-an-inch bore. At the bottom of this tube is fixed a stop-cock, to enable me to let out any of the diatoms during any stage of the process. Having nearly filled this tube with distilled water I pour in my deposits washed free from the acids. I watch the deposit as it falls slowly and gradually down the tube. In about a quarter of an hour many of the larger forms will have descended to the bottom of the tube. By turning the tap at the bottom of the tube I let out a drop of the mixture on a slide;" and so he proceeds, waiting a longer interval between each turning of the tap to allow of the lighter forms settling. In this manner they are tolerably well sorted into sizes. The only weak point about this plan is that it merely separates bodies of the same specific gravity, so that foreign matter is not eliminated, but sinks with the diatoms. The larger specimens which descend with the grains of sand in the first fall may be easily picked out.

Prof. Bailey, in Silliman's Journal, recommends the following: "Dissolve out the lime compounds if present by means of nitric acid or hydrocloric acid, then wash and filter; put the moist contents of the filter into a porcelain capsule, with enough strong sulphuric acid to make the whole a fluid mass. Heat the capsule over a spirit lamp until the organic matters are all charred, and continue the heat until strong acid fumes are evolved. Keep the capsule hot, and, in minute portions at a time, add finely-powdered chlorate of potash. If the acid is hot enough to give off fumes, the chlorate will be immediately decomposed without the accumulation of explosive gases, and it will exert so powerful an oxidizing action that in a few moments a carbonaceous material as black as ink will become clean and colorless. Nothing will now remain to be done but to wash off the acid, which is best done by the addition of water and repeated decantations. I would advise that the material thus cleaned should not be dried, but should be kept in bottles with a little alcohol, which prevents felting together, and does not allow of the byssoid plants which often develop in water. It is necessary to caution those not familiar with chemistry against using the chlorate of potash with sulphuric acid in any other way than that above

directed, as violent and dangerous explosions might result. The process as given above is perfectly safe and very effective."

If the student does not choose the mode of separation prescribed by Monro, he may, by using a long dipping tube, arrive at somewhat the same results. The washed and clean deposit may be stirred up in a cylindrical glass measure, and the drippings of the first sediment examined under the microscope. He will then probably find large grains of sand mixed with the large specimens of diatoms. Dr. Carpenter recommends that these diatoms should be pushed on one side by means of a bristle inserted in a wooden handle. If this plan is adopted great gentleness must be used, as even with such a comparatively delicate instrument a rough touch will end in the fracture of the fragile frustule. For this purpose Prof. Redfern suggested the use of split hairs, such as may often be found in an old shaving brush. These do not appear to split until they are pressed on the diatom, when they open and grip it like fairy forceps; but even here care must be employed lest a fracture of the valve ensues. Mr. William Borrer, Jr., devised an arrangement for picking out and arranging diatoms which was attended with great success. It may be described as a collar of cork fitted on the lower end of a low-power objective, and through which a needle is thrust obliquely. To the end of the needle one of the barbed lancets of a bee's sting, or what is even better, the bristle from a rat's tail, is cemented. By adjusting the point of this in such a manner as to be in focus at nearly the same time as the diatom, it can be brought down on to it gently, and, as it adheres to the barb, it can be raised and transferred to a clean slide. Some mounters of diatoms acquire dexterity in cleaning, selecting, and mounting these minute frustules, as evidenced by the slides of A. C. Cole and L. Hardman, and the still more marvellous achievements of Herr Möller. The student will generally be content if he can mount diatoms cleanly and suitably for his own satisfaction.

Of late years a search has been made with the view of finding a suitable medium in which to mount diatoms. Balsam stands a chance of being relegated to the back row, the fault found with it being its low index of refraction when used with the high-power immersion lenses, but taken all round, and except for comparative tests, it is far the most convenient medium. Gum styrax finds support from some, and a preparation introduced by Dr. Van Heurck, of Antwerp, of which styrax forms a good proportion, gives very good results, and at the same time is convenient. Its mode of use is simple. A small portion is warmed slightly and put on a warm cover-glass, which is inverted, and gently allowed to fall on the side on which the diatoms are placed Not too much heat must be employed or annoying air bubbles will form, and not too much pressure used or the diatoms will be broken. This preparation is very dark to look at in the mass, but as a very thin layer exists between the cover and the slide it may be regarded as sufficiently colorless for this and for many other mounting purposes. It remains unchanged in character for years. American styrax hardens just like balsam, but when heated becomes extremely fluid. Having a high refractive index, it is particularly useful for the finer diatoms. On account of its fluidity when heated it is better for the smaller diatoms during the process of mounting lest the cover sink down on the larger forms and crush them.

J. W. Stephenson finds a valuable resolving power in a solution of phosphorus in bisulphide of carbon; for the amateur it would be advisable not to play with so highly inflammable a solution. Prof. H. L. Smith and Mr. W. C. Meates have devised media in which sulphur, arsenic, and bromine are compounded, and although they give admirable mounts when first set up, after a time crystallization sets in and spoils the slide. It will be as well to be content for the present with balsam and Van Heurck's preparation.

Associated with diatoms the collector will often find desmids These may be distinguished from diatoms by their bright emerald-green color. The desmidieæ are a family of fresh-water algæ, and are among the most beautiful objects either from their transparent green color or from the great diversity of their form. Unlike the diatoms, the desmids grow only in fresh water, and prefer a quiet pool in an open and exposed situation, and although they may be found in streams, it will be useless to seek them unless the stream is a very slowly running one. Small shallow pools in boggy ground are the most likely spots for them, and they may be easily collected by the shallow spoon recommended for the collection of diatoms, if, like them, they are spread on the surface of a muddy bottom. When they grow on the stems of aquatic plants, these may be gathered bodily, and transferred to a glass bottle of water. If they are scattered through the water, they may be collected by a small muslin ring-net, to be described later on, and the net turned inside out in the bottle of water, when the desmids will be washed off, and if this is placed in the sun-light on reaching home the desmids will be found by the next morning congregated at that side of the bottle nearest the light, and tolerably free from contamination.

Mounting media for desmids which will preserve their beautiful colors are still to be invented. There are only two which seem to act fairly well. Some add camphor water to that in which they have been growing, when they may be mounted in it. This plan answers as well as any and is to be preferred. Others employ a preservative solution: Distilled water sixteen parts, alcohol one part, and a few drops of creosote; stir in a small quantity of chalk, and filter. Mix the liquid with an equal part of camphor water, and before using make a cone of stout blotting-paper the size of an ordinary thimble, and filter as much as required for one mounting on the slides, the desmids to be mounted having been previously placed. A good preservative for these, and also for delicate algæ generally, is a solution of one part of acetate of alumina to four parts of distilled water. With all these good mounting media the color after a time disappears from the endochrome, and only the outer form remains to tell the story. One species will always excite interest, whether we regard its animal-like movements or the violent vicissitudes through which it has to pass. It may often be found in the metal gutters of buildings, where it is subjected to such extreme heat that the hand brought incautiously in contact with the metal in the height of summer is speedily withdrawn, or it may be found on the Alpine snows in the depth of winter, where it is better known as "red snow" than by its botanical name, *Protococcus pluvialis*. The dried-up powder in the metal gutter will often afford a crop when placed in water and deposited near a window, when, in a day or two, that side of the water near the light will be found swarming with pale green moving

bodies. A dip may be made with the tube, and the drop examined under the microscope in a shallow cell, when an immense number of pear-shaped bodies, having a red spot somewhere about them, will be seen in rapid locomotion. No means whereby this motion is accomplished are visible. If a most minute dose of a solution of osmic acid be allowed to absorb itself under the cover-glass, by putting the drop of solution on one side of it, and a small piece of blotting-paper on the other, as it abstracts the water it allows the osmic acid solution to take its place. This almost instantly kills the protococcus, and soon it begins to assume a darkened appearance, when its small end, two long slender filaments, will be seen, which, lashing the water, propel the alga along. The osmic acid may now be withdrawn by the same method by which it was introduced, distilled water taking its place. There will always be enough of the osmic acid left in the fluid to act as a preservative, when the cover-glass may be cemented down.

[*To be continued.*]

The Significance of Sex.*

By HENRY L. OSBORN,

HAMLINE, MINN.

There is, perhaps, no more noticeable nor less intelligible fact in biological science than sex. Except among the lowest living things, especially in the animal kingdom, two living beings, more or less alike, yet more or less unlike, must co-operate in order to the perpetuation of the species. The fact of death necessitates the fact of birth, and students are eagerly seeking the meaning of both. In the lower animals the asexual modes of reproduction seem to provide for the unlimited propagation of the species. I say seem, for even in the protozoa conjugation is not proven to be unessential, though an event of comparatively rare occurrence. In animals so highly developed as *Arthropoda* parthenogenesis, or the development of eggs which have not been fertilized, shows us a way in which higher animals with all their complex organization can be perpetuated by the action of the female sex alone. Upon a zoölogical philosophy, which should exclude evolution, an explanation of sex would be extremely difficult.

If evolution be the true history of the animal kingdom, and the existing diversity of form be due to transmission from parent to offspring, we can at once see a possible meaning for sex. Evolution requires two factors: the conservative one, by which to explain the resemblances between animals or plants, and another to be the vehicle of divergence. Many facts seem to point to the conclusion that sexuality is the mechanism of evolution; that is, that it is through sexual reproduction that divergence in animal and vegetable structure is produced. Thus in horticulture, for instance, it is very noticeably the case that where a desirable form is sought to be perpetuated propagation is from buds, grafts, etc., which are asexual products, and not from seeds which are true sexual products. Again, in those cases in the animal kingdom where true parthenogenesis takes place, it is very strongly held by Brooks, Weismann, and others, though demonstrative evidence has not

* The Evolution of Sex. By Patrick Geddes and J. A. Thomson. London, 1889.

yet been furnished, that the posterity will be unvarying. Thus asexual reproduction, or unisexual reproduction, tends to the conservation of ancestral form, and does not lead toward diversity from the ancestral type. Sexual reproduction, on the other hand, is plainly the cause of variation, as seen in the history of plant propagation from seedlings, and also from the breeding of domesticated animals. Thus no one feels any confidence in assigning the breed of mongrel dogs, though he would have no hesitation in recognizing that of one true bred. The disturbing influence of an ill-bred male is believed by breeders to affect not merely the immediate offspring, but even subsequent births, so that very great caution is exercised in crossing when an effort is made to introduce a new variety. It is thus very likely that the meaning of sexuality will be connected with the cause of diversity and resemblance in the animal kingdom.

The recent literature upon this subject has assigned to the female sex the function of retaining and transmitting the racial peculiarities which appear in the offspring, and has assigned to the male sex the office of causing the change, slight though it be, by which the offspring departs from the racial type, and which divergence seized on by natural selection may become the starting-point of a new species. The full history of the egg is not known in all cases, but it is likely that some of the material of the egg is set aside at a very early date in the segmentation, and this unused portion is carried along in the developing body to become its generative tissue. If such were the case parthenogenesis as the propagation of an unvarying posterity becomes intelligible, for the offspring must be like the parent since it is produced from some of the same substance. The origin of ova may thus be compared with reproduction among the protozoa; in *amœba* a spherical nucleated cell divides into two, which separate and go each upon its separate history; in the metazoa the egg cell subdivides into two, one portion goes on and divides and produces a member in the genetic series, the other remains dormant, and the date of its activity is the date of arrival of the parent at maturity. Each generation thus at its birth prepares for the succeeding generation, and the chain is one of children like their parents. Brooks, Weismann, and others claim that this succession would permit of no variation. Geddes is not certain that this is true so absolutely, but still such a mode of descent would allow but little variation. Sexual reproduction also finds its representative in the reproduction of the protozoa, for conjugation has very long been considered and taught to be in some sense an equivalent process, and this is not the only form of the union of two individuals for the purpose of reproduction, for in the myxomycetes numerous amœboid bodies unite to form one body, and in the algæ and low animals there is the union of two unlike members in conjugation.

Passivity then is the function of the female and activity of the male, and this is the keynote of our authors' work. In the elaboration of this thesis they make very many observations which are of the most fascinating interest, but cannot receive attention here. According to the view of this very recent English writing on the subject, we may regard the ovum as a potential organism in which the tendency to repose is very strong and whieh contains a large store of nutritive material, while the spermatozoon is an organism in which the tendency to activity is

immense but the supply of food is very slight; the union of the two brings the activity of the spermatozoon to supplement the inertia of the ovum, while the nutritive matter of the ovum supplies food to permit the activity which the spermatozoon excites. The generative products are not the only portions of the organism which partake of these characteristics, but they are true in many ways of the organism at large. The superior activity and aggressiveness of males is well known, their great excitability in times of sexual function, and the passivity of the female. The high coloration of males, the development of sundry cutaneous structures, such as horns in the male deer at the breeding season and many other sexual characters, are attributed to the high physiological activity of the creature, and taken as evidence of a much more excitable nature on the part of the male. The history of the spermatozoa is that of elements similar in origin with ova, but so active that one may say they had no time to grow and accumulate any nutritive material. Embryos up to a certain stage may be said to be sexless. It seems to be a general law that if at this time they be fed in certain ways, they will become male or female. The bees know this, and can, by feeding worker embryos, make them become fertile females or queens. The well-fed larvæ thus tend to passivity. Tadpoles can be experimented upon and their sex predetermined by the way they are nourished; those well fed become females, while under-nutrition produces males. In the human race in times of war when means of subsistence are scanty and mothers are less well nourished on the average, the majority of births are of males, whereas in times of peace the balance is the other way. Nutrition is not to be regarded as the sole factor predetermining sex, but probably an important one, and these facts show that it is correct to regard the female sex at large as well nourished and passive, and the male as less so and active.

The authors explain sex thus: The protoplasmic activity is either anabolic (constructive) or katabolic (destructive), and the sex of any organism is the result in it of preponderant anabolism or katabolism. The dimorphism or difference of sex is then the result of preponderant constructive activities in one individual and preponderant destructive activities in another. All intermediate degrees are to be seen as very effeminate men (inactive physically and mentally) and very masculine women (active physically and mentally), intensely female women and intensely male men; so that in some the preponderance of anabolism is large, in others it is slight. Sexuality is thus based on protoplasmic activities, and is the result of certain balances of activities, and sex finds a meaning in terms of protoplasmic physiology. This dimorphism of sex furnishes the vehicle through which has been evolved diversity of form, and natural selection has seized upon it through the conservative passivity of the female to propagate a race of resembling members, through the radical experimenting activity of the male to reach out and found new and advancing types.

DEC. 26, 1890.

Obituary.—Dr. Henry V. Hull died March 27, 1890, at Coeymans, N. Y., from acute lung difficulty. Although but 38 years of age, he was already a physician of established reputation. He was a member of the N. Y. State Microscopical Society, and connected with the County Medical Society. He practised medicine in Coeymans, but afterwards in Schenectady, where he remained until a few months ago.

Things to be Remembered by Chemists, Druggists, and Microscopists.

By H. M. WHELPLEY, M. D.,

ST. LOUIS, MO.

1. Remember that saltpetre and sulphur may explode if pounded in an iron mortar.

2. Remember that powdered camphor can be kept in the pulverent form by the addition of one-half per cent. of oil of vaseline.

3. Remember that sugar added to ordinary ink forms a good copying ink.

4. Remember that quinine will preserve mucilage, paste, etc.

5. Remember that aniline colors fade with age. Records should not be written with aniline ink.

6. Remember that sulphureted hydrogen water is best preserved in glass stoppered bottles, with the stopper protected by vaseline.

7. Remember that cherry laurel water and morphine salts are liable to form the poisonous cyanide of morphine.

8. Remember that powdered rosin may produce spontaneous combustion.

9. Remember that an application of a weak solution of hydrochloric acid, followed by a weak solution of chlorinated lime, will remove logwood stains from the skin.

10. Remember that rose water made with carbonate of magnesium and used to make eye-water, by dissolving zinc or lead salts, will form an irritating precipitate.

11. Remember that many celluloid articles can be mended by covering the edge with glacial acetic acid, and pressing them firmly together until dry.

12. Remember to mix acids with water, by pouring the acid into the water and not the water into the acid, as the latter process may cause an explosion of steam.

13. Remember that the etherial solutions of iodoform are not permanent.

14. Remember that the granulated gum-arabic dissolves more readily than the powdered.

15. Remember that choral and cyanide of potassium mutually decompose each other, and that hydrocyanic acid is one of the products.

16. Remember that pyroxylin should be kept packed in glass and moist with its own weight of water.

17. Remember that glycerine administered in large quantity may produce poisonous symptoms.

18. Remember that when alcohol and water are mixed the combined volume is less than the sum of the two separate liquids.

19. Remember that alcohol stains varnished surfaces.

20. Remember that moistening aconite tubers with alcohol before powdering in a mortar will prevent the irritating dust from rising.

21. Remember that carbolic acid is combustible.

22. Remember that iodine and the iodides precipitate the alkaloids.

23. Remember that scaly iron salts dissolve more readily by adding the scales gradually to the menstruum than by triturating in a mortar.

24. Remember that acetate of lead loses some of its acetic acid when exposed to the air.

25. Remember that cocaine and borax form an insoluble borate of cocaine, while boric acid and cocaine do not.

26. Remember that black lead is not plumbum, but a form of carbon.

27. Remember that eulyptol is a proprietary preparation, and differs from eucalyptol.

28. Remember that five parts of phenol with ninety-five parts of water, or five parts of water with ninety-five parts of phenol, form clear mixtures.

29. Remember this much of the Metric system: 1,000 milligrams make 1 gram; 1,000 grams or cubic centimeters make 1 kilo or liter; 1,000 kilos make 1 ton; 65 milligrams make 1 grain; 15½ grains make 1 gram; 31 grams make 1 ounce troy.

Medical Microscopy.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

Absence of Casts in Nephritic Urine.—We do not always find casts in specimens of urine taken from typical cases of nephritis. The reason is that the casts are dissolved after their formation, either by chemical solvents, or, more frequently, from the presence of pepsin in the urine. This solution may take place either in the bladder or after the urine is passed, if it is allowed to stand in a warm room. Therefore, examinations should be made with specimens recently passed and which have remained in the bladder only a short time.—*E. Sehrwald in Deutsch Med. Wochenschrift. 1890, No. 24.*

St. Petersburg is to have an institution for the study of bacteriology to cost $330,000.

Efforts to Cultivate Cancer Germs.—Endeavors made by Drs. C. A. Ballance and S. G. Shattock to produce artificial cultures of suppostitious cancer germs have yielded purely negative results. The culture-medium used was blood serum. Notwithstanding these results, the authors do not claim that the theory of the parasitic origin of cancer is overthrown. They suggest that the micro-organism of cancer may belong to the *Protozoa*, and not to the *Protophyta*.—*Proceedings of the Royal Society.*

The Koch Excitement.—We quote from our contemporaries some opinions regarding the reputed wonderful discovery of Koch.

The Southern Medical Record advises us not to " fly off the handle " at every suggestion of a new and wonderful discovery.

The Buffalo Medical and Surgical Journal says: " First, patients should not rush to Berlin under the hope that cure is at hand, and second, the profession ought not to use the remedy until they know what it is."

The Brooklyn Medical Journal says: " It is too early to pronounce the treatment a success, and the greatest boon to humanity of the nineteenth century, etc."

A writer in the *Courier of Medicine* says: " Of course there will be

disappointments, there will be a reaction; but that a new epoch is dawning upon our science there can be no reasonable doubt."

The *Omaha Clinic* says: "We fail to find the smallest excuse why American physicians should allow their unfortunate patients to dare the ocean and the weather to seek relief at the hands of this remedy at this stage of its use."

The American Practitioner and News heads its remarks upon the subject, "The Consumption Cure Craze."

The N. Y. Medical Journal says: "The main question of the curative efficacy of the Koch liquid seems hardly nearer a solution than at first."

The American Lancet says: "Criticism is impossible, as the facts are still so few."

Journal Am. Med. Ass. says: "In the onset of this intense excitement it is needful that our medical men shall pursue a conservative course. It is not needful that they shall be skeptical, nor that they shall prejudge the facts."

In our own mind fear is uppermost that the outcome will consist largely of diappointment. We suggest that if the curative "lymph" consists wholly or in part of a by-product of the tubercular bacillus, each patient suffering from tuberculosis produces within himself a more than sufficient amount of this substance.

No Universal Germicide.—Until quite recently it appears to have been the aim of investigators in medical bacteriology to discover some drug which should destroy or inhibit the growth of every species of pathogenic micro-organisms. The search has been a failure. If such a drug exists, it is probably so poisonous to human beings that it can be used only with the greatest caution, bichloride of mercury, for example. A more promising search is that for substances fatal to given species of microbes. These may have no effect upon other species, and will not necessarily be poisonous to man. To draw a coarse illustration, the Dalmatian insect powder is effective against the house fly, but does not kill the Colorado beetle, for which Paris green is a sure poison. So it is probable that the physician's armamentarium will soon consist, not of one or two powerful and poisonous germicides, but a dozen or more, each fatal to a certain class or species of disease germs, and some of them at least, we hope, entirely non-poisonous.

Submembraneous Local Treatment of Pharyngeal Diphtheria.—In the *N. Y. Medical Journal* of Dec. 6, 1890, appears a paper, with the above title, from the pen of A. Seibert, M. D. The paper appears to us of such transendent importance that we briefly summarize it. Local antiseptic treatment in diphtheria, gargles, sprays, etc., have proven of little avail, because the causative bacilli develop, not on the surface of the mucous membrane, but in its deeper layers, from within outwards. Germicides applied to the surface do not reach them at all. Dr. Seibert, therefore, proposes to inject the germicide *beneath* the affected mucous membrane by means of an instrument, described and figured, specially devised for the purpose.

After experimenting with many drugs, he selected a 0.2 per cent. solution of chlorine water as the most suitable germicide. He reports seven cases treated by submucous injections of chlorine water, with most satisfactory results. It is essential that the treatment be applied

in the early stages of the disease, and it is, of course, not applicable to cases of laryngeal diphtheria. The paper deserves perusal by every live physician.

Teaching Microscopy.—We commend the method of teaching Microscopy which is practised at the Toledo Medical College. Fresh material is stained by well-recognized methods and given to the students without any previous knowledge of its nature. The student is required to identify these unknown specimens. In this way have been demonstrated the various forms of epithelium, non-striated and striated muscular fibre of frog and rat, the different forms of muscular fibre of the heart, liver cells, etc. *Tinea favosa* was diagnosed by demonstrating the mycelium and spores of *Achorion Schönleinii*. Among other objects studied were the parasite of Scabies and the *Trichina spiralis* in human muscle and in the muscle of the white rat. Later follows the study of hardening, cutting, staining, and mounting normal tissues, and the study of abnormal specimens, together with general microscopical diagnosis.—*Medical Compend.*, *Dec.*, *1890*.

MICROSCOPICAL SOCIETIES.

Birmingham Natural History and Microscopical Society.

1890.—During the year the President was Mr. C. Pumphrey; Secretary, Mr. W. H. Wilkinson. Nine meetings of the microscopical section were held, with an average attendance of thirty-one, and the following communications were made:

March 4.—"On Painting Lantern Slides direct from the Microscope," by Mr. H. M. J. Underhill, of Oxford; read by Mr. W. P. Marshall.

April 1.—"Optics of the Microscope," illustrated by drawings and lantern photographs, by Mr. J. Edmonds. The lime-light lantern worked by Mr. C. Pumphrey.

April 29.—Mr. W. B. Grove gave the retiring President's address on the "Theory of Instinct," which was listened to with great interest.

May 6.—"Report on the Foraminifera obtained at Hammerfest by Messrs. Pumphrey and Marshall," by Mr. E. Burgess; read by Mr. W. H. Wilkinson; and a slide, containing fifty species, mounted by Mr. Burgess, was presented to the Society.

June 3.—"Corals, Coral Builders, and Coral Islands," by Mr. W. R. Hughes, illustrated by drawings and by specimens of coral and of coral builders preserved in spirit.

Nov 4.—"Reflectors as used with the Microscope," illustrated by various mirrors and models, by Mr. W. H. Wilkinson.

Dec. 2.—"Burmah and its People," by Mr. A. W. Wills, illustrated by lime-light views from photographs taken by himself during his recent tour there.

At the sectional meetings a large number of specimens were exhibited, and among many members who gave exhibitions were Mr. J. E. Bagnall, plates of fungi and mosses; Mr. W. B. Grove, minute fungi; Mr. W. R. Hughes, flowers and plants; Mr. C. Pumphrey, Alpine and other plants; Mr. C. J. Watson, an interesting collection of plants from Norway; Mr. G. M. Iliff, glow-worms; Mr. A. Reading, a

scarlet fungus; Mr. Carpenter, fine specimens of coral; Mr. G. Lavender and Mr. T. E. Bolton, living specimens of pond-life; Mr. W. H. Wilkinson, lichens from Norway, birds and plants from Wales.

NOTICES OF BOOKS.

The Post-Graduate Clinical Charts. By Wm. C. Bailey, M. D. and J. H. Linsley, M. D. New York, 1891.

These elaborate charts were originally prepared for use in the Post-Graduate Hospital. Each book holds the record of one case for eight weeks. They seem admirably adapted for hospital use and for those cases of which it is desired to keep an exhaustive record. For the busy practitioner they seem to us too bulky. In the chart for disease of the lungs there is a column for recording the number of injections of "tuberculin," and the number of milligrammes injected. Few physicians will find use for this column at present.

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.]

WANTED.—Vol. VII, No. 2 (Feb., 1886), of American Monthly Microscopical Journal.
A. G. YOUNG, State House, Augusta, Me.

WANTED.—Diatom material from America, Australia, and Asia in exchange for fossil and recent material from Denmark.
CHR. MICHELSEN, 33 Nedergade, Odense, Denmark.

FOR EXCHANGE.—Slides of diatoms from peat bogs in Boston, Mass.
F. F. FORBES, Brookline, Mass.

WANTED.—Vol. I, American Monthly Microscopical Journal.
C. K. WELLS, Marietta, Ohio.

WANTED TO PURCHASE.—Histological slides from normal tissues of mammals, prepared with a view to show the size of the "cells," in cases where the age of the animal-subject is definitely known, as bearing on the question of a supposed diminution in the size of cells in aging organisms, corresponding to a similar decrease, reported by Balbiani and Maupas in aged unicellular life. Address,
C. A. STEPHENS' LABORATORY, Norway Lake, Maine.

WANTED.—Diatomaceous material of good quality, fossil and recent. I offer diatom slides or photo-micrographs in exchange.
D. B. WARD, Poughkeepsie, N. Y.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts.
PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species.
E. BOSTOCK, Stone, Staffordshire.

WANTED.—Any works on Microscopy not already in my Library.
H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

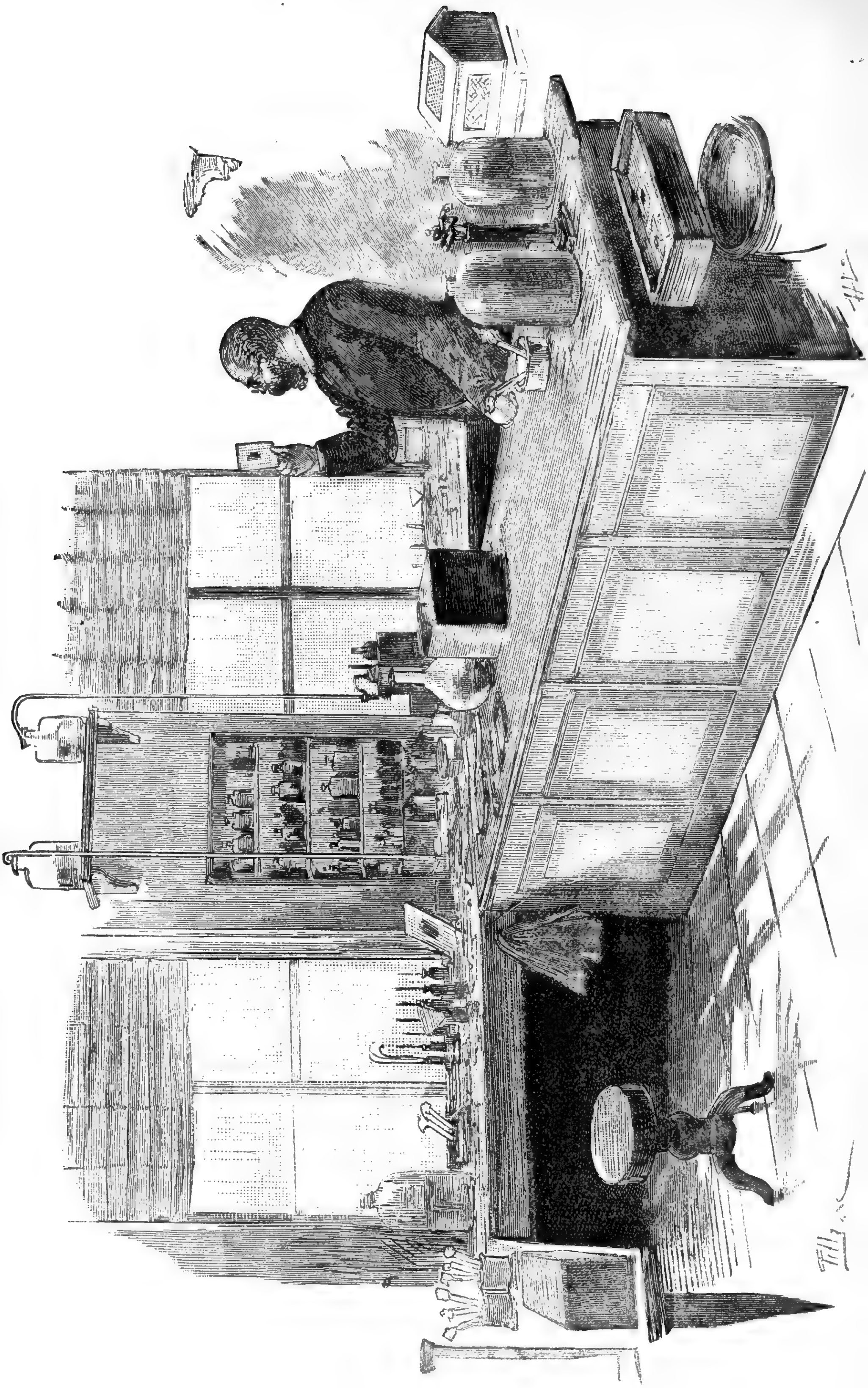
First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares.
S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

FOR SALE OR EXCHANGE.—Mosquitoes, male and female. Price 75 cents each. Will exchange only for first-class mounts.
E. W. SHARP, 2800 Richmond St., Philadelphia, Pa.

A $5 MICROSCOPE.—Made on proper scientific principles. Magnifies 100 diameters or 10,000 times. For other interesting articles send for list of Popular Scientific Specialties.
G. S. WOOLMAN, 116 Fulton St., New York.

SPECIAL BARGAIN in histological slides.
WM. N. BEGGS, M. D., 2207 Sidney St., St. Louis, Mo.

FOR SALE OR EXCHANGE.—Photo-micrographs of P. angulatum taken through Spencer's $\frac{1}{10}$ H. I., 2400 diameters. Also photo-micrographs of bacteria, diatoms, etc., 25 cents each. Will exchange for well-mounted slides.
DR. J. E. BAKER, Wyoming, Ohio.



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All communications for this Journal, whether relating to business or to editorial matters, and all books, pamphlets, exchanges, etc., should be addressed to American Monthly Microscopical Journal, Washington, D. C.

European subscriptions may be sent directly to the above address accompanied by International Postal Order for $1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

Koch's Cure for Tuberculosis.

BY FREDERICK GAERTNER, M. D.,

PITTSBURGH, PA.

[WITH FRONTISPIECE—KOCH IN HIS LABORATORY.]

Joyous acclamations resound throughout the whole world, and Berlin it is whither the pilgrimage turns its way. Thither they hastened—the sick and wretched, who at the watering-places in vain sought restoration of health; thither they hastened—the physicians of all nations, to learn from the pupils of the master the great art of healing consumptives.

Koch, the conqueror of the *bacillus tuberculosis*, has spoken and has again wrung from the world amazement and admiration. Science celebrates again a triumph, so great, so unexpected, that the achievements of many contemporaries sink into comparative insignificance. Few, very few indeed, were able at the first moment to appreciate the magnitude of this triumph of science.

We have already told the history of its growth and of its battle with the human organism; we also have sent forth Robert Koch's announcement that he was fast nearing the goal, and that he was about to find a remedy for tuberculosis.

We have already proclaimed the existence of a method of cure by which consumption in its first stages may be combatted with good results; a remedy, very tedious and long protracted, by which the human organism is assisted and strengthened in its battle against the tubercle bacillus and enabled to free itself and cast off the enemy.

We have now a remedy which works directly against the progress of tuberculous disease. This alone is a triumph of science without considering whether or not the remedy is infallible in every case. Robert Koch, the discoverer, gives it to us, but at first he did not like to tell

us of what it consists. He had well-grounded reasons for this. Finally he tells us that it is a glycerine extract of tubercle-bacilli (aus den reinculturen der tuberkel bacillen); besides this the lymph contains (eine gawisse menge von mineral salsen, farbende substansen und andere unbekannte extractivstoffe) a natural product of the animal organism; one fact alone we know with certainty, that this remedy cannot be manufactured nor produced in any chemical laboratory. We suspected it to be prepared from the diminutive bacilli, which are compelled to reveal themselves to the great investigator. Until now the world has known but little of this remedy, only that it consists of a brownish, clear fluid which upon the animal organism produces wonderful effects. Through the stomach the fluid will not act at all. It

FIG. 1.—A Pure Culture of Tuberculous Bacilli (600 Dia.)

must be injected under the skin, and thus after it has mingled with the blood it affects the whole organism. The action varies according as the patient is suffering from tuberculosis or not.

Upon persons who are free from tubercle-bacilli, even though suffering from other diseases, the effect of the fluid is slighter. The symptoms of a healthy person after an injection of 0.25 ccm. Koch himself has experienced after an injection in the arm, and he describes the reaction as follows:

A few hours after the injection he felt a drawing or twinging sensation in his limbs, lassitude, an inclination to cough, and difficulty in breathing. In the fifth hour severe chills came on, nausea, vomiting, and an elevation in the temperature to 39.6 c. (102 Fahr.) At the expiration of twelve hours these symptoms gradually passed away, and only a heaviness of the limbs and lassitude continued for a few days.

Further tests revealed the fact that the new remedy begins to affect a healthy adult only after the injection of the one-hundredth of a cubic centimeter. But few persons are affected by a very slight fever, the greater number being sensible of only slight pains in the limbs and a passing lassitude.

Not so with healthy persons, or with those not suffering from tuberculosis. The reaction after the injection has an entirely different effect upon those who are affected by tubercle-bacilli. Two distinct phenomena become evident.

First, a general reaction takes place upon the body. This reaction makes itself known after the application of a small dose by a high fever, together with a streaked exanthema upon the breast and neck. This passes away in from 12 to 15 hours. In the second place, the parts infiltrated with tubercle-bacilli are affected by the destructive action of the remedy.

When the affected parts are visible to the eye, as in Lupus (phagendic rash), a tuberculous disease of the skin appearing in knots which

FIG. 2.—B. Tuberculosis from Fresh Mucus (400 Dia.)

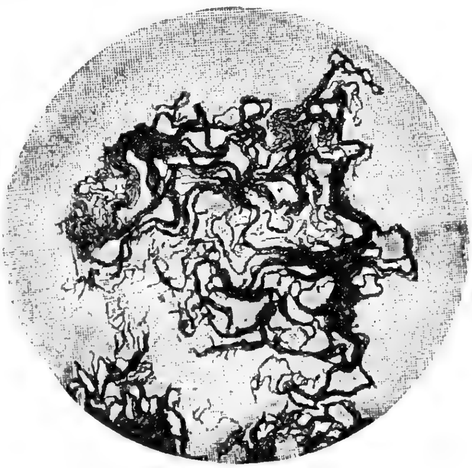

FIG. 3.—B. Tuberculosis after 14 Days.

by and by wholly destroys parts of the skin, the progress of the action can be exactly observed. The diseased parts then swell, become inflamed, and separate themselves from the healing skin, then change into crusts or scabs, which after two or three weeks fall off, leaving a smooth scar.

The tubercle-bacilli are not killed by the new remedy (the lymph), but the tissues immediately surrounding the tubercle-bacilli are destroyed, and are cast out of the organism as dead and useless parts. With the dead tissues the tubercle-bacillus is expelled from the body.

Where the diseased tissue is near the surface, as in the skin, the expulsion of diseased tissue is easily accomplished, but in the interior organs the process is slower, and during the time of action the organism is threatened by the danger of the still living bacilli passing from the destroyed necrosed tissue into the healthy parts. The art of healing must then come to the assistance of the body when necessary, and by

surgical procedure hasten the expulsion of the dead tissue. The healing process is thus by no means simple, as was originally represented, and the danger of relapse is by no means excluded.

Since tuberculous diseases are chronic and Koch's method of treating human beings has been practised to any extent only during the past few months, it is therefore possible already to speak certainly of real cures. But one thing is positive, that in all lighter cases the improvement has been so marked that the patient may be regarded as cured; considering the shortness of time this is a result such as never yet followed the application of any other remedy or the employment of any other method of cure. In advanced stages where considerable parts of the organs have been destroyed, particularly of the lungs, this remedy seems also to be futile.

The first official statistical record made by Professor Guddstadt under the supervision of Minister Von Gossler, of the Prussian University Clinics and Pathological Laboratory, out of 1,061 cases affected with *internal tuberculosis*, 13 were completely healed (cured), 171 were decidedly greatly improved, 194 improved, 586 were not improved, and 46 cases of forlorn hope died from the effects.

These tests, so far as they are known to us, justify a definite hope of curing tuberculous diseases with safety and certainty in their early stages. By this fact alone the question of cure is decided; since in the future every suspected case of tuberculosis will be submitted to the Koch remedy, and thus really serious and advanced cases will no longer exist.

With the decrease in the number of afflicted, the danger of contagion through excretion and expectoration will be diminished. In regard to that other source of contagion, namely, the tuberculous diseases of cattle, it is easily seen that these diseases of domestic animals may be cured and their numbers diminished; thus in time we will no longer need to fear tuberculous milk.

Remedies have heretofore been discovered, but principally by accident; this was the case with quinine for malarial fevers, and with vaccination against variola; but now accident plays no rôle. Koch ventured forward step by step upon the path of science. He searched for the cause and found it in the tubercle-bacillus; he sought for a remedy to reach the bacillus in the body and he has found it. The remedy is not designed, as was at first supposed, to kill the bacillus with one blow; it merely changes the process of the disease in our favor. It is not infallible, it may not cure in many instances, but it is the most powerful weapon with which the medical profession has yet been able to combat this invisible enemy. This fact alone secures Robert Koch an imperishable fame.

The first step is always the most difficult. Since Koch has become master of the tubercle-bacillus it is now only a matter of time to discover remedies for other infectious diseases, such as typhus, typhoid, diphtheria, small-pox, cholera, yellow fever, scarlet fever, etc. Hereby Koch's discovery opens a new epoch. A retrospect upon his life shows a continued glitter of scientific triumph which we owe not only to his far-seeing genius, but also to his endurance and his untiring diligence.

Dr. Robert Koch was born Dec. 11, 1843, the son of a higher officer of the mines. His cradle stood in Clousthal, 'mid the Harz Mts. He was graduated at the University of Göttingen. It was not his fortune at

the completion of his medical studies at the University to devote himself to specialties. He was compelled to enter upon practical life, and after taking his degree he established himself in a village near Hanover and began to practise as a physician. He then migrated to Rackwitz, a little malarious town in Prussian Poland, which he subsequently deserted for Wollstein. Meanwhile he studied. The microscope was his weapon, and he revealed from his quiet retreat a series of bacteriological labors which drew to him the attention of learned men.

It was in 1880 that his name came before the public as an expert in connection with the famous Speichert poisoning case. The conviction of the prisoner in this *cause célèbre* was entirely owing to the remarkable analysis and medical testimony of Dr. Koch. His profound erudition attracted wide attention. Later he made some remarkable accurate studies in septicæmia. In 1882 he first made the great discovery that tuberculous diseases are due to the existence of bacilli. In 1883 he was placed at the head of the German Cholera Commission, and was sent into Egypt and India. In Asia he unmasked a second hidden enemy of mankind—the cause of cholera—the comma-bacillus. He was rewarded by the German Government with an honorarium of 100,000 marks, with the rank of Privy Councillor, and with the Rectorship of the Imperial Institute of Hygiene.

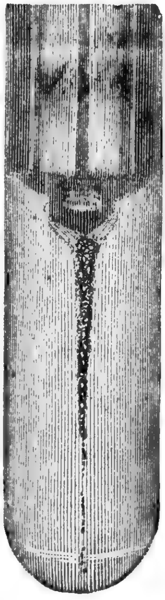

Fig. 4.—Culture of Cholera Germs.

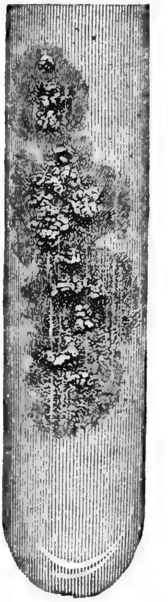

Fig. 5.—Culture of Tuberculosis Germs.

Thus far the great public had but one misgiving. Koch had revealed the enemy, but was unable to destroy it. Now he has accomplished even this; now he is able to destroy the tubercle-bacillus both within and upon the surface of the animal body.

The public scarcely asks how Koch made his discovery, but in this method of Koch's lies the great cause of amazement and admiration.

The bacteria (Fig. 1, commonly called germs) appear under the microscope as mere points, lines, and commas; many are hopelessly similar. How could a distinction, a differentiation, possibly be made in this confusion, or these characteristics be studied?

Koch modestly attributes the result of bacteriology to the perfection of the microscope. But the best microscope would be useless were we not in possession of Koch's methods. He ascertained how to provide fostering soil for the minute beings; he understood how to regulate the confusion existing in a drop of virus, so that each moment we are able to separate a certain kind and study it in its simple state.

What Koch has accomplished is now known throughout the civilized

world. He is in the very prime of life and full of hope and joy. He will surely surprise us with new achievements, and in the future will, we hope, carry the art of healing from triumph to triumph.

Hypnotism.

By HENRY L. OSBORN,

HAMLINE, MINN.

The obscure phenomena of psychology, some of which have been known very many years and have been practised for the most part by charlatans or for the amusement of audiences of a somewhat dubious grade of respectability, are now in the way of being well sifted by scientific students, and the good in them, if any, brought to light and utilized. The modern methods of psychological study, the improved ways of studying the neurological aspects of psychic phenomena, the very active spirit of inquiry which now so thoroughly inspires every department of science and more particularly the science of biology, and the numerous possible applications of hypnotism in medical practice and even in the legal profession, have combined to raise the study of the phenomena of mesmerism from the realm of mere guess-work or wanton curiosity into the field of serious scientific attention. Albert Moll, of Berlin, has* written the best exposition of the subject of the many which have recently appeared in the English language.

The biological world has too long sneered and scoffed at hypnotism. A very large preponderance of indisputable facts now renders it practically certain that hypnotism has played a large part in the mental history of many delusions on a large as well as a small scale, that it must be recognized as a possible factor in all cases where we have to deal with the mind of another. The physician must allow for it, so, too, the judge and jury, and the teacher. Dr. W. B. Carpenter long ago in his admirable "Mental Physiology" called attention to the importance of expectation or the "predominance of an idea" in an explanation of mesmeric and allied phenomena. Prof. Moll, from his investigation of the phenomena, thinks that the facts of hypnotism are not *sui generis*, but are only peculiar manifestations of ordinary mental activities, heightened because of undivided attention. Three factors will suffice to explain all the facts of hypnotism; 1, expectant attention; 2, external suggestion; 3, the ordinary operation of the laws of mental association. All of these are operative in normal psychic life. Thus, for example, a judicial examiner at an exhumation declared that he smelled a putrefactive odor; when the coffin was opened it was found empty. Here expectation produced an hallucination of the sense of smell. The force of external suggestion is, if we notice it, constantly operative in daily life. How largely we shape our actions in conformity with the laws of society, *i. e.*, what is expected of us.

Hypnotism is a matter of degree; in some cases there is, on the part of the subject, perfect concurrent consciousness with obedience to the suggestion of the hypnotizer. At other times there is only faint con-

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* Hypnotism—Contemporary Science Series. Scribner, N. Y.

sciousness, or, finally, complete suspension of consciousness when the subject is a mere machine in the hands of an operator. In the last case the hypnotic, on return to consciousness, retains no recollection of his acts during the hypnotic trance.

Thus far the older writers, and the writers of to-day, run along parallel tracks.

The latest developments in hypnotism, and those which seem likely to make it of value to medical science and practice, are in the department of "post-hypnotic" suggestion. This term refers to the state of those cases where the hypnotizer impresses upon a subject that a certain action is to be performed or omitted at some future time—an impression which has ruling force when that time arrives. Thus an inebriate is hypnotized and then told that he can only drink liquors with his meal, and finds that this suggestion rules action in that department even after the recovery from the hypnotic trance. Post-hypnotic suggestion can thus be used to apply to a single form of action, and the general mental life left untouched.

Dr. Moll explains such cases upon the action of the law of association, and thinks that the subject, when hypnotized, has the image of the future time and the motor-image of the act so strongly associated that later on, when the one arises, or the arrival of the time, the motor-image is drawn up by it, and leads to action.

It being well known that mental expectancy has vastly important effect in even such bodily conditions as vasomotor phenomena, and perhaps secretion, to say nothing of the more definitely controllable phenomena of cerebral and muscular activity, it is evident that a physician who can by suggestion guide the mind of his patient so as to remove from him the expectation of a fatal termination of disease and replace it with hope of recovery has a valuable remedy in his reach which is perhaps in some cases not inferior to drugs or surgical means. The man who can, without interfering with normal mental life, touch the abnormal mental state of the kleptomaniac or the drunkard and heal it, will do for that sufferer from mental malady as much as the physician strives to do for the physical frame of man. Hypnotism may perhaps be used in relations which have a legal aspect, for a hypnotized person could be made unconsciously to execute a legal document, or perhaps even to perpetrate a crime.

The neurological aspects of cases of hypnotism are not as yet at all clearly elucidated. The suggestion has come from Prof. Haidenheim (cf. Encyc. Britt., vol. xv, p. 283) that hypnotism is a phenomenon of inhibition wherein the motor areas of the cerebral cortex are thrown "out of gear," and actions then are performed automatically we may say, or under the dominance of images which came in through the senses and without the operation of judgment. This view implies that the conscious centres and the centres of motor action are identical, and this has by no means been proven. The physiology of hypnotism can not be said to have yet received much exact study, but it is now beginning to receive much serious attention. We can hardly doubt but that the time has now arrived when it will rank as a department of the study of human biology.

HAMLINE, MINN., *Dec.* 26, '90.

Fresh-water Rhizopods of Oakland County, Michigan.

By STUART H. PERRY,
ANN ARBOR, MICH.

The list of species given in this paper is the result of about two years' study of the Rhizopoda of Oakland county. The localities I have searched are the usual habitats of the Rhizopoda, including the numerous lakes, ponds, and streams in the vicinity of Pontiac, for sphagnum moss and the stems and leaves of aquatic plants. In general I have found sphagnum when growing in shady situations to be most productive, although the largest variety I ever observed in a single gathering was from Clinton river, among the fine, thread-like roots of the willow. I find the habits substantially as described by Prof. Leidy in his work on the Rhizopods of the United States, which has been my chief authority in classifying the following list:

1. Amœba proteus.
2. " radiosa.
3. Ouramœba vorax.
4. Dinamœba mirabilis.
5. Difflugia pyriformis.
6. " urceolata.
7. " globulosa.
8. " constricta.
9. " spiralis.
10. " corona.
11. " lobostoma.
12. " acuminata.
13. Arcella discoides.
14. " vulgaris.
15. " dentata.
16. " mitrata.
17. Pseudodifflugia gracilis.
18. Englypha olveolata.
19. " ciliata.
20. " cristata.
21. Cyphoderia ampulla.
22. Centropyxis aculeata.
23. Campascus cornutus.
24. Trinema enchelys.
25. Clathrulina elegans.
26. Vampyrella lateritia.
27. Hyalosphenia elegans.
28. Actinosphærium eichornii.
29. Actinophrys sol.
30. Acanthocystis.
31. Heterophrys.
32. Radiophrys.

Of these species I found Nos. 1, 5, 6, 7, 8 common; 3, 4, 16, 17, 27 rare; 2, 9, 10, 11, 12, 14, 18, 21, 28 rather common; 13, 22, 29 very common; 15, 19, 20, 30, 31, 32 occasional; 23 a single specimen observed. This species was first described by Leidy, and found by him only in China lake, Yinta Mts., Wyoming; 24 common in sphagnum; 25 not common; 26, I found this very abundant with Œdogonium in a bottle in my laboratory.

If possible Rhizopods should be examined and studied while alive, but the testaceous forms may be mounted so as to show very well many of their characteristics. I find the best medium for mounting to be glycerine jelly, in which the specimens do not become too transparent as they would in balsam, and the sarcode is preserved, though of course somewhat contracted. As fresh-water rhizopods are seldom sufficiently plentiful to warrant the treatment by levigation which facilitates the separation of Foraminifera and Diatoms, it is usually best to pick them out singly with a fine camel's-hair brush under a power of from 25 to 125 diameters, transferring them to a drop of glycerine, where they may remain indefinitely until required for mounting. When a single species is very abundant, however, time may be saved by carefully washing the material and finally isolating the specimens as described.

Pontiac, Mich.

Diatoms: Their Life History and their Classification.

BY REV. FRED'K B. CARTER,

MONTCLAIR, N. J.

(*Continued from page 6.*)

The article by J. D. Cox on *Isthmia Nervosa*, in the *Amer. Jour. of Microscopy* for 1878, page 97, deserved more careful consideration than could be given to it at the time the second portion of this paper was sent to the printer. As Carpenter has misrepresented Cox, it is only fair that the readers of this Journal should know just what the latter did say in that article.

"Examination fully sustained *Dr. Wallich's statement* (italics mine) that the hoop of Isthmia is often found to be of two or more concentric tubes, which slide over each other during the multiplication of the diatom by division. * * * The simplest case is that of a diatom with a hoop wide enough for the formation of the new valves. Here the ripened hoop is at least double in thickness; * * * one thickness of the hoop separates from the other at one end by a suture of the inside film, and at the other end by a suture of the outside film, and the two slide over each other till they slide apart. Many cases of this kind have been observed in which the parts of the old hoop are persistent, and form the hoop of the new diatom. * * * If we suppose that in any species no sutures occur in the hoop, except near the connection between hoop and valve, no cast hoops would be found except when accident had broken the frustule, for the two lamellæ would adhere, one to the old and the other to the new valve. * * * In regard to *Isthmia* the cases observed seem conclusively to prove that the hoop proper is a permanent part of the diatom, except when the separation at the sutures is such as to leave a portion of the hoop free at both edges, in which event the separation of the young frustules drops this segment of the hoop."

Instead, therefore, of calling in question Wallich's statement, J. D. Cox *agrees* with Wallich and with H. L. Smith as to the regular formation in *Isthmia*. Moreover, he does not once use the phrase '*a third hoop*' in all that paper. What he says is this: "The thick band commonly visible in the growing diatom may be caused by the simple lapping of two tubes, but it may *also* be caused by a *real band* (italics mine), the division taking place at its two edges simultaneously, and the divided inner hoop sliding both ways out of the band, which is loosened and falls when the separation is complete, giving one of the most common forms in which a perfect cast hoop is found, both margins being smooth and unbroken."

So far then from claiming "a third hoop" as a new discovery, Cox simply affirms his agreement with Wallich's statement and immediately passes on to the real matter of his article, which was intended to elucidate entirely different points. Carpenter therefore has misrepresented him, and it is a matter of regret to me that I have done anything to perpetuate that unfair criticism. I trust, however, that this explanation may make amends for what was entirely unintentional. I was misled by Carpenter's note. Cox's paper is worthy of close study and should be consulted by every one who is interested in this subject.

In a former portion of this paper I said that there would always be

some of the frustules which, in spite of repeated subdivision, would keep their normal size, one for every individual of the species represented at the time division begins. And that of the size represented by the smaller valve of each of those frustules there would be twice as many. In other words, that only one of each succeeding pair of frustules is smaller than the frustule from which the two are produced. Moreover, *that one* will be smaller all around simply by the thickness of the hoop at each division. Thus there will be a considerable number of frustules which will not vary much from the size of the diatom when multiplication began. And I also said the result of subdivision was often a decrease in size in the case of the desmids and of the infusoria; that is, that such decrease was not confined to the diatoms, not merely the result of a siliceous covering. On reading over that statement it occurred to me to look up the extent of variation in individuals of the same species among the desmids and I was surprised to find how wide it was in many instances. Here are the figures for some 40 species covering 17 out of the 19 genera enumerated by Wolle:

Hyalotheca:		
disilliens,	Diam.	20– 36 μ
dubia,	"	13– 21 "
Bambusina:		
Brebissonii,	"	18– 25 "
Desmidium:		
aptogonium,	"	25– 38 "
Sphærozosma:		
pulchrum,	"	60– 82 "
serratum,	"	22– 33 "
Mesotænium:		
micrococcum,	"	6– 11 "
Spirotænia:		
obscura,	"	8– 15 "
Penium:		
digitus,	"	60– 80 "
lamellosum,	"	55– 80 "
Closterium:		
obtusum,	"	5– 11 "
augustatum,	"	15– 25 "
striolatum,	"	30– 48 "
Leibleinii,	"	40– 60 "
Docidium:		
crenulatum,	"	40– 60 "
truncatum,	"	50– 75 "
coronatum,	"	22– 56 "
Calocylindrus:		
connatus,	"	45– 75 "
minor,	"	20– 40 "
Cosmarium:		
ovale,	"	62–112 "
quadratum,	"	20– 40 "
pyramidatum,	"	50– 85 "
Ralfsii,	"	60–100 "

Tetmemorus:		
granulatus,	"	38– 50 "
Xanthidium:		
armatum,	"	62–140 "
cristatum,	"	40– 55 "
Arthrodesmus:		
incus,	"	10– 36 "
octocornis,	"	16– 25 "
Euastrum:		
ansatum,	"	25– 36 "
elegans,	"	18– 36 "
binale,	"	15– 25 "
Micrasterias:		
radiosa,	"	150–200 "
truncata,	"	50–100 "
Jenneri,	"	100–150 "
pinnatifida,	"	83–110 "
Staurastrum:		
pygmæum,	"	16– 25 "
pentacladum,	"	40– 70 "
controversum,	"	38– 65 "
Brasiliense,	"	87–130 "
Eustephanum,	"	50– 75 "

Comparing these figures the variations will be found to range from $\frac{1}{3}$–$3\frac{3}{5}$. That is to say, the *same species* may include individuals $\frac{1}{3}$ larger than others, $\frac{1}{2}$ larger, $\frac{2}{3}$ larger, twice as large, yes, three times as large in diameter. The desmids, then, do not seem to keep their size much better than the diatoms in spite of the fact that they have no siliceous casing to contend with. In many cases it is true the variation may not be due to decrease, but however caused it is a departure from any fixed size. I simply wish to point out that all individuals between these extremes are classed as belonging to the same species. Allowing, then, the same amount of variation to the diatoms it is evident that we might have a large number of frustules which would well represent the specific size even after repeated subdivisions. As the size only goes down in one of the pair of frustules at each division, and then only by a portion of the diameter equal to double the thickness of the hoop, it will take quite a number of divisions to use up the allowable extent of variation from $\frac{1}{3}$–$3\frac{3}{5}$. For all those variations cited in the case of 40 desmids are stated as occurring in individuals which are classed by Wolle as species, not varieties. The diameter of *Xanthidium armatum*, for example, is 62–140 μ; of *Euastrum elegans*, 18–36 μ; of *Arthrodesmus incus*, 10–36 μ. If a desmid can vary that much, and yet all the variations be classed as members of the same species, not varieties, it is only fair to allow the same range for a diatom. The difference in size therefore of individuals of the same species among the diatoms is not so remarkable after all. If some are a third, a half larger than others, twice as large, three times as large, the same is just as true of the desmids.

But wait! I believe I have made a discovery. It would seem as if there must be something wrong again either about the received theory or the drawings in many instances. For by the theory the diatoms must

decrease in size after subdivision, and they must decrease *both ways*—in *length* as well as in *breadth*. The frustules ought to become *shorter* as well as narrower, for the outer hoop limits the inner all the way round. But according to the drawings they do not decrease in length in a number of cases.

Take, for example, the drawings of *Licmophora* (fig. 172, p. 342, Carpenter's 6th edition; Nave's Handy Book, pl. vii; Wolle, Diatomaceæ, pl. xxix, fig. 1), or look at *Meridion circulare* (fig. 170, Carpenter; Wolle, pl. xxxvii, figs. 24, 25, 26; Micrographic, pl. 17, fig. 7 a); *Bacillaria paradoxa* (fig. 171, Carpenter; Wolle, pl. lxviii, figs. 32–34); *Eunotia pectinalis* (Wolle, pl. xxxvi, fig. 19); *Synedra pulchella* and *superba* (Wolle, pl. xli, figs. 26, 32); *Odontidium*, *Sphenosira*, *Tabellaria*, *Tetracyclus* (Micrographic, pl. 17, figs. 14 a, 26 b, 27 a, 28; Wolle, pl. l); *Asterionella*, *Diatoma* (Wolle, pl. xlvi, figs. 5–8, 14, 21–27); *Fragilaria* (pl. xlvii, figs. 1–7); *Striatella* (Wolle, pl. li, fig. 1; Micrographic, pl. 17, fig. 20 b); *Stylobiblium* (Micrographic, pl. 18, fig. 50 b; Wolle, pl. lxii, fig. 25); *Achnanthes* (Wolle, pl. xxvii, figs. 22, 29, 33). In fact the instances are so many that I am getting tired of citing the references. If you will look at these figures you will see that after several subdivisions the frustules *do not vary in length at all* in many cases, and that in some they vary, if anything, the wrong way, the frustules becoming longer instead of shorter. The radius of the spiral of *Meridion* or of the fan of *Licmophora* is represented as constant. In *Fragilaria*, *Himantidium*, *Tabellaria*, and *Tetracyclus*, the upper and lower lines of the filament are drawn *parallel*. One frustule is just as long as another, and so it is with *Asterionella* and *Diatoma*. It would seem, therefore, as if there must be something wrong about the theory or else about the figures. Either the frustules in many cases do not decrease as the text-books say they do, or else the figures do not correctly represent the facts. They ought to become shorter, whereas they are figured as being all equally long, or the difference is so slight as to be inappreciable. Certainly any one looking at the figures would say the frustules were of the same length in the majority of the cases I have cited.

And now comes the climax; for in turning to the Rev. Mr. Smith's synopsis on this point of multiplication by division, I find to my amazement that he not only asserts that in many cases they do not decrease, but that they actually *increase!*

"The new valves" he says "formed during the process of self-division ordinarily appear exact counterparts in form and size of the valves of the original frustule; but careful examination of the process in the filamentous species has led me to conclude that a slight enlargement occasionally takes place in the new valves, thus causing a widening of the filament.

"This increase is, however, so small that in a filament of many hundred frustules the enlargement is scarcely appreciable. The rapid attenuation represented by some authors in the filaments of the *Fragilariæ* must, therefore, be attributed to the deceptive appearance presented by a compressed band when slightly twisted, the semblance of attenuation being thus given to the portions which are presented in an oblique direction to the eye of the observer.

"The increase in the new valves, although slight, will, however,

sufficiently account for the varying breadth of the bands in the filamentous species and the diversity of size in the frustules of the free forms, without obliging us to suppose that a growth or aggregation takes place in the siliceous valve when once formed. Starting from a single frustule, it will be at once apparent that if its valves remain unaltered in size while the cell-membrane experiences repeated self-division, we shall have two frustules constantly retaining their original dimensions, four slightly increased, eight somewhat larger, and so on, in a geometrical ratio, which will soon present us with an innumerable multitude containing individuals in every stage, but in which the larger sizes preponderate over the smaller, and such are the circumstances ordinarily found to attend the presence of large numbers of these organisms." *

I say nothing about his reasoning, but simply call attention to these two points: 1. That he declares that in a filament of many hundred frustules the difference in size is scarcely appreciable; and, 2, that when we find these organisms present in large numbers the *larger* sizes predominate over the smaller.

So much, then, for this mode of reproduction, namely, by division. The other is by conjugation, but I shall not enlarge upon it, simply mentioning that Wolle says there are three methods: 1. Two frustules producing a single sporangium; 2, two frustules producing two sporangial cells; 3, a single frustule, by differentiation of contents, producing one sporangium; and the last he says is the most common of the three.

[*To be continued.*]

Microscopy for Amateurs.

By T. CHARTERS WHITE,

QUEKETT CLUB.

[*Continued from page 65.*]

Infusoria.—To pursue this branch of study with convenience and comfort, sundry accessory apparatus will be required. One may stand by a promising pool and gaze with longing eyes at an aquatic plant, which is loaded with life, but without the means of getting it. A collecting-stick must be obtained. This looks like an ordinary walking-stick, but artfully conceals joints in its interior by which it can be lengthened. The student takes it on his walk. But the stick is not enough; he must have something to hold his infusorial life. Nothing answers this purpose so well as the screw-top York bottles, obtainable of most chemists. One or two of these are carried in the pocket. Sold with the stick is a metal ring, having a screw thread within it which fits the screw on the York bottle. By another screw on its side it may be firmly and securely attached to the stick, so that when the bottle is screwed into the ring, and the ring is screwed to the stick, and the joints of the stick are joined, we have a piece of apparatus as long as a fishing rod, but stiffer, and which will reach out to the middle of any ordinary pool. But you say, "How will this get up the water plants I want?" In the collecting kit you ought to find a sharp sickle-shaped hook, which will screw into the end of the stick when the screw carry-

* Rev. Mr. Smith's Synopsis, Birt. Dict., vol. 1, p. xxxvi.

ing the bottle is removed. This, taking the place of the ring, can be thrust under the water and the coveted plant reached and brought to the surface.

Avoid the necessity of carrying home a useless burden of weed. For this purpose there are various home-made appliances in the shape of square and round clear glass bottles, but the handiest, as also the most efficient of these appliances, may be constructed thus: Take two pieces of clear patent plate glass, about three and a half inches square, grind their edges, and cement with marine glue between them, at the side and bottom, some slips of stout plate glass. This forms a strong shallow form of trough, in which aquatic plants may be placed for examination by the pocket lens. The parallel sides of the glass trough favor the examination. Portions of the plant may be selected for further inspection, and placed in separate tubes. It is not a good plan to huddle everything collected into one stock bottle. Remember that over-crowding in any shape is not only detrimental to animal existence, but even fatal. In addition to the collecting-stick, bottle, ring, and hook, a muslin ring-net and a shallow spoon as recommended in diatom and desmid collecting should be added. Arriving home from a hunt the material will need further examination, distribution into separate glass tanks, and placing in the light of a north window, the direct rays of the sun being prejudicial by over-heating a small quantity of water, and by favoring the inordinate growth of confervæ. Many collectors and breeders of infusoria seem to consider the pleasant summer afternoon the only and proper times for these collections. No greater mistake can be made, for though they may be rewarded by the capture of forms of great beauty by confining their operations to this one season of the year, they leave uncaptured many forms in their early and transitional stages. Visit those same ponds in the winter, and beneath the snow and ice is an abundant harvest of material. You can develop the ova of many of the fresh-water fauna. For this purpose a slide, capable of being transferred to the stage of the microscope at any time without disturbing the object under observation, must be added to the stock of accessory apparatus. Such a slide is known as *a growing slide*, and many forms have been devised.

It often happens that in examining a gathering an organism is met with about which the observer would desire to know more; but to transfer it from his slide to one of the growing slides in ordinary use would most probably result in its loss or destruction. The slide now about to be described is designed to supercede the use of the glass slip generally used for this purpose, so that should such an organism present itself it is not necessary to disturb it, but simply to insert an inlet and an outlet thread of darning cotton in the openings at the sides of the cell, attaching the inlet thread to a small reservoir of water a few inches above the microscope stage, when a continuous current favored by the capillary attraction of the cotton threads is made to pass through the cell. Any number of these slides may be constructed by the microscopist himself, for by having half a dozen or so at hand it becomes an easy matter to put any one having an object of interest on it aside for future examination. They are designed with a view of being put away in the grooves of a slide box. Plain directions may here be given for making them. The slide consists of the usual glass slip (3

inch by 1 inch), having a narrow ledge of glass (about $\frac{1}{8}$ inch wide and extending nearly its whole length) cemented to its lower border with marine glue; to this is cemented at right angles a strip of thin covering glass about $\frac{1}{4}$ inch wide and about $1\frac{1}{8}$ inch from the end of the slide, having a narrow channel cut through it for the passage of an intake thread. A similar strip having a like cut through it for the passage of an outlet thread is cemented at the same distance from the opposite end of the slide. In this condition, the slide being filled with water any current coming in through the intake thread would pass directly across the top of the water in the cell and pass out by the outlet thread, and organisms near the bottom of the cell would not be benefited by a change of water; therefore, cement a very narrow strip of the same covering glass as before to the inner side of the outlet end of the cell, commencing at the top of the slide and extending to very nearly the bottom, so as to leave about $\frac{1}{16}$ inch between. If the intake thread is connected with a bottle of water placed above the level of the slide, water entering by the intake thread will pass in a diagonal direction to the left and bottom of the cell, where the influence of the suction set up by the syphon-like action of the outlet thread makes itself felt, and there is a regular current.

The front of the cell is formed of a piece of covering-glass of $1\frac{1}{2}$-inch by $\frac{3}{8}$, and two small square blocks of glass, cemented on each side, will hold the covering-glass sufficiently firm to prevent it sliding on the organism and crushing it.

Such a growing slide will hold about one drachm of water, and, taking the rate of the drops from the outlet thread as about one per minute, the whole of the water in the cell is changed once in an hour, while, at the same time, the current is not sufficiently strong to carry away more than the finest and lightest bodies. It allows a fair observation with a $\frac{1}{4}$-inch objective, and, if desired, could be made with thinner glass, so that a $\frac{1}{6}$-inch or $\frac{1}{8}$-inch might be employed.

In using this growing slide any reservoir of water placed slightly above the level of the stage will answer the purpose of supply; but the author has had a support fixed to the movable stage of his microscope which carries a small bottle of water at a suitable height, and thus the water supply and the growing slide are made to move simultaneously without any disturbance of the object during its examination; in this manner he was enabled to carry on continuously for two months the observation of the development of *Corethra plumicornis*, when the successive changes in its organization were carefully noted and drawn.

Delineation of Objects.—Drawings from microscopical observation are made by means of an optical arrangement placed over the eyepiece of the microscope, and called a camera lucida. There are many forms of this instrument, but the principle is the same. The rays of light from the object are reflected at an angle, and the object made to appear as if projected on the drawing paper, when its outline and detail can be drawn with a pencil. Some are made to be used when the microscope is in a vertical position, which is most convenient for the examination and drawing of infusorial life. But if confined in a shallow trough the microscope may be placed horizontally, and a camera lucida made upon the following principle may be used: The cap of the eye-piece being removed, a collar of brass may be substituted, carrying

a reflecting mirror at an angle of 45° with the optical axis of the microscope. Some are made to carry a small mirror the size of the pupil of the eye, others of larger extent, but with all it is necessary to keep the eye in a fixed position till the drawing is finished. The plan of proceeding is as follows: The microscope being inclined until it comes to a horizontal position, the cap of the eye-piece removed, and the camera lucida put on, it must then be determined to what extent the drawing is to be enlarged. If it is to be the size it is magnified, the same distance must be maintained between the camera lucida and the paper as exists between the camera lucida and the object magnified; but by increasing the distance between the camera lucida and the paper the magnification of the drawing can be increased proportionately. Thus, if the eye-piece carrying the camera lucida be projected beyond the edge of the table, the drawing can be made large enough for a diagram, but the pencil must be elongated to reach the paper on the floor, and the hand and eye must be very steady in order to successfully accomplish such an enlarged drawing. A better plan is to invert a small simple microscope carrying the object to be drawn, and, on illuminating this in a dark room, cast its image on drawing-paper, then in proportion as the microscope is elevated above the table so will the enlargement be increased; not only this, but the natural colors of the object may be painted in. An exceedingly simple and efficient camera lucida may be constructed by a cap fitting the eye-piece, carrying a square of cover-glass at an angle of 45°. This, if broken, can be easily replaced. Its upper surface reflects the image of the object, which, on looking through the thin glass, appears on the drawing-paper beneath, and if this paper is fixed to a drawing-board with the usual pins, the drawing may be discontinued and resumed at leisure, a few trials being sufficient to bring about a readjustment of the image to the outlines.

Information on other forms is given in Dr. Carpenter's work. In drawing with the camera lucida it is important to so arrange two lamps that, while one dimly but clearly illuminates the object, the other should throw the fullest light on the pencil; but the apportionment had better be left to individual requirements. It however aids to have the cedar-wood drawing-pencil freshly cut, that the light wood, shining up through the under surface of the reflector, may be a guide to its whereabouts. Many beautiful drawings, full of detail, have been made by simply copying the image, as seen in the field of the miscroscope, by dropping into the eye-piece in the focus of the eye-glass a circle of glass ruled in equal squares, and copying the image as a map is copied. Whatever method is employed the drawing entails a vast amount of careful labor and a great expenditure of time. Errors may creep in, and therefore photo-micrography, or the art of photographing microscopical enlargements, comes in to insure complete veracity with a saving of labor.

Photo-micrography.—This is the converse of micro-photography (the making of such small photographs as to require the aid of the microscope to render them visible), while photo-micrography is applied to the portrayal of microscopic specimens by photographic enlargement. The reason for mentioning this distinction is to correct an impression very generally prevalent that these terms are mutually convertible and may be used with indifference.

In all the processes heretofore described, the microscope has been employed in conjunction with the camera, and beautiful results have been attained. But in the method introduced now we discard the use of the microscope entirely. Two advantages are claimed for this. First, the field of view is only limited by the size of the sensitive plate employed, a great range of amplification is obtained by varying the distance between the objective employed and the sensitive plate, and an amplification suitable to the object can be selected. Second, the ability to see your image and arrange it according to the part you desire to photograph; this can be done on the ordinary ground focusing glass of the camera, but when the image is thrown on a white ground, as it is in this apparatus, it is more easy to select any particular portion and to focus it roughly. This method is only suitable for photographing transparent objects. It is more immediately designed for the delineation of histological subjects.

Imagine an oblong lidless box laid on its side and securely screwed to one end of a base-board two inches in thickness and two and a half feet in length. The upper central part of this base-board, about one inch in thickness, is made to slide in a dovetailed groove; the end of this sliding part carries the holders for the plates employed, this holder being an ordinary printing frame, from which photographic negatives are printed. The size of the holder may be varied according to the amplification required, and this sliding holder can diminish or greatly extend the magnification as may be desired. The upper side of this box has an oblong opening cut in it, over which a tin chimney is fixed, thus allowing the lamp to approach or recede from the object stage as may be desirable. Another opening is made in that side of the box which faces the plate-holder and central with it; this opening is closed by a movable brass plate, having an adapter with the standard microscopical screw soldered into it. This permits any objective with the Society screw-gauge being employed. Below this plate a support carrying the movable stage is fixed to the side of the box, this stage being moved backwards and forwards by a long micrometer screw. The object to be photographed is made to approach or recede from the objective till a sharp image is thrown on the screen. The best focusing screen is made by covering an old glass plate of any of the standard sizes intended to be employed with a sheet of the smoothest white paper by means of gum. This enables the operator to arrange the object according to his judgment, and permits of a certain amount of rough focusing. The finest focusing must be arrived at by other means. Another plate of plain glass put into the holder and having *fine* lines drawn a short interval apart with a writing diamond (on its surface which faces the objective) is looked at from the back through an ordinary eye-piece or with a photographic focusing glass. When the details of the object are seen sharply at the same time as the fine lines, a sharply defined image will be thrown on the sensitive gelatine plate, which it is intended shall occupy in the holder the place now occupied by the plain glass.

The light is derived from a microscopical lamp burning the purest paraffine oil, in which is dissolved a lump of camphor of the size of a walnut to the ordinary reservoir full; this whitens the flame and renders it more actinic. A plano-convex lens with the convex side toward

the flame serves to concentrate the light on the object. A curtain of black velvet falls over the front of this arrangement, shutting all light in, and a shutter cuts off the rays coming through the objective till all is ready for the rays to fall on the sensitive plate during the proper time of exposure.

The lamp lighted and placed inside of the box is allowed to burn a short time before commencing work, so that the wood and brass work may be warmed. If this is not done the expansion of these materials after focusing the object will result in a blurred picture. A microscopical slide may next be placed in position, and its projected image arranged on the white paper surface of the focusing screen. Learn by the character of this image whether it will require a long or a short exposure, whether it reveals much detail or is marked by its entire absence, or whether its color favors photography or not. If the object or its image possesses detail of a fairly well marked character, and the object is not too thick, a successful result will follow the correct exposure. And now you are brought face to face with the first of the difficulties.

In the manner of normal exposures by lamplight, Mr. W. H. Walmsley gives the following table, which may be taken as approximate, but may require modification for each operator: When using a $1\frac{1}{2}$-in. objective, 3–45 seconds; $\frac{2}{3}$-in. objective, 7–90 seconds; $\frac{4}{10}$-in. objective, $\frac{1}{2}$–3 minutes; $\frac{1}{5}$-in. objective, 2–7 minutes; $\frac{1}{10}$-in. objective, 4–10 minutes.

Having selected an object and focused the image, cut off the rays of light from the screen and shut in every vestige of light. Now, being in perfect darkness, light the non-actinic lamp; these are sold of various patterns, but may not be actinically safe. That recommended is a paraffine lamp with all light blocked out through the reservoir, an argand wick, and a tubular chimney well coated inside and out with Thomas' ruby varnish. This will afford abundance of safe light at eighteen inches distance. By this light take the sensitive plate from its box and put it into the focusing frame, when its gelatine surface ought to be in exact register with the fine diamond markings by which you get the true focus. Then open your objective, and let the image of your preparation fall on the gelatine plate for the number of seconds or minutes given in Mr. Walmsley's table, after which shut off the light again, and proceed to develop. Some operators prefer the ferrous oxalate developer, while others adopt that which is known as the alkaline pyrogallic acid. Some who have used both, although having got very good negatives with the pyrogallic acid, prefer the ferrous oxalate, because it does not stain the fingers. As some may like the simplicity as well as the cleanliness of this developer, it may be well to give the formula for making it. Having made two saturated solutions, one of neutral oxalate of potash and another of sulphate of iron, add them together in the proportion of one part of iron to three parts of oxalate of potash, *taking care always to add the iron to the potash.* It makes a dark sherry-colored mixture. If it is feared that the plate has been slightly over-exposed, add a few drops of a ten per cent. solution of bromide of potassium, which, acting as a restrainer, keeps back the too rapid development of the image. Keep up the development until the general ground of the plate does not transmit any light, and every detail will be brought out in the image. Then give the plate

a good rinsing in a pail of water and place it in the fixing bath. The fixing solution is made by dissolving four ounces of hyposulphite of soda in a pint of water; let the plate remain in this some minutes after the bromide of silver, which has not been acted upon by the light and which remains yellow, is dissolved out, when it may be removed and washed copiously in running water, dried spontaneously and varnished.

This photographic arrangement reduces photo-micrography to the greatest simplicity, and enables any one to delineate sections or membraneous tissues. When powers higher than one-fifth of an inch focus are used, it might be desirable to have a more powerful light than that afforded by the paraffine and camphor, but, as a rule, that will be found sufficient, especially if the edge of the wick be presented towards the object. A further use to which this apparatus may be put is as a projection microscope. A screen of tracing-paper taking the place of a focusing screen, and of any convenient dimensions, may be made to receive the image in a darkened room, when several persons may examine it with as great facility as if looking at it through the microscope. With a plane mirror, silvered on its face and fixed at an angle of 45°, the course of the rays as they pass through the objective are thrown down on a sheet of drawing-paper, and thus the image may be traced and even portrayed in its natural colors.

[*To be continued.*]

Medical Microscopy.

By F. BLANCHARD, M. D.,
WASHINGTON, D. C.

Pasteur and Hydrophobia.—Many physicians still look upon Pasteur with suspicion. Possibly the following facts, recorded by Dr. Tomkins, of Leicester, England, in the *London Lancet*, may serve to allay such feeling:

On the same day, a stray dog bit two children, a man, and a dog. The stray dog was then killed, and its spinal cord removed and taken to Pasteur along with the three bitten patients. The bitten dog died of hydrophobia on the eighteenth day. Rabbits inoculated from the spinal cord of dog No. 1 died of hydrophobia. The human subjects, two of whom were badly lacerated, still are in perfect health at the end of twelve months. They remained under Pasteur's treatment from fourteen to twenty-five days.

Rarefied Air and Red Blood Globules.—Some observations made by Viault in the high mountains of Peru tend to the belief that residence in a rarified atmosphere stimulates the blood-making function. After fifteen days spent in the mountains he found that the number of red corpuscles had increased from 5,000,000 to 7,100,000 per cubic millimetre.—*La Tribune Med., Dec. 25, 1890.*

The Characteristic Organism of Cancer.—Dr. W. Russell, in the *Provincial Medical Journal* for January 1, 1891, gives the results of his prolonged microscopical study of cancer. In the affected tissues he has invariably found certain organisms which he provisionally calls "fuchsin bodies," because they were originally discovered by using a double stain of aniline green and fuchsin. In size they vary from half

as large to twice as large as a red blood corpuscle. They are found within the epithelial cells. They appear to multiply by budding, and Dr. Russell is of the opinion that they are of the nature of a fungus. He also thinks that their multiplication is sufficient to account for cancer growth.

BOYS' DEPARTMENT.

Buying Microscopical Outfits.

By E. C. HOYT,

DETROIT, MICH.

"Have I a word for the boys this month?" Yes, as to buying goods. Many are more competent to give information or advice to younger amateurs than myself, and a fear of giving offence rather conflicts with my disposition to tell the truth and tell it plainly. I had almost concluded to keep my experience in some directions to myself, especially as I have, after over two years effort, finally succeeded in disposing of my outfit. Had I never invested in a microscopical outfit (or even invested intelligently) the funds used would have placed me in much more comfortable circumstances than I am in financially to-day.

I have had occasion heretofore in other journals to criticize somewhat severely what I regard as unjust prices. When I began purchasing about ten years ago, I was in the employ of a hardware manufactory. In that line catalogues are issued with prices called "List prices," and discounts vary from 25% to 80%. When I first inquired for discounts on microscopical goods I was told, "Prices in catalogue are net." Having no guardian at the time I purchased freely, until I had expended over $1,500, and generally at full catalogue prices, accepting in good faith the statement that there was no discount on "microscopical" prices.

I am now prepared to say to "the boys" that while any one who pays full prices, as per catalogue, may not be a consummate idiot, at the same time he is in need of a guardian, and upon application I can refer to one in whom confidence may safely be reposed, though there is no money in it for me.

The superintendent of a large factory of optical goods told a friend of mine that the profit made was at times over 400%, but even with this immense profit they seem not to be willing to let the *dealers* in for their share, and private individuals often obtain the discount of 20%, I am told, if they know enough to remit less 20%. I have a friend in New York who is a dealer. He is agent for certain objectives, a regularly-appointed agent. I knew of three people wanting his first-class 1-10ths. I endeavored to aid my friend by telling him of this want. He wrote to the parties, but he did not sell to them. Three objectives were sold from the factory for $180.00—a little less for the buyers, a little more for the makers, leaving the dealer, a legitimate position, out for his time, postage, and paper.

I have too deep a reverence for the revelations of the microscope to feel that this is as it should be. The microscope is too noble an instrument to be used for ignoble purposes. It is the same "trust" upon

which business is being conducted in other lines, and against which every honest heart must revolt. The whole profit, large as it is, is absorbed by one or two persons. A few years ago in the lumber business the profit was divided among several middlemen. Now, the lumberman spells his name in capitals, and clears the land, rafts his logs, builds a village, owns it entirely, saws his logs, and not content with this, establishes in hundreds of towns retail yards, under a variety of names, and gets retail prices. Every penny of profit from the tree to the retail price goes into the lumberman's pocket. A very few in number control all yards west of Chicago.

Perhaps no two things would seem farther removed from each other than the microscope and the saw-log, but the business is getting to be conducted upon the same principle in the one case as in the other.

Were it not for dissuading some person from *ever* investing in the line of microscopical goods, I would suggest the wisdom of buying an entire outfit (exclusive of slides) at one time. The cost might stagger one at first, but much money could be saved by so doing. I could have saved $500 had I been wiser, and known what I know now. A beginner often purchases accessories of no practical value, or accessories which have a practical value in themselves, but not required in addition to other accessories. Hence the need of advice apart from what the dealer will give.

But don't pay full prices if you can help it; don't go to a drug store and try every patent medicine advertised to cure your particular pain. Get a physician on the start. Appoint him your guardian, and buy what he prescribes. If you want to buy a microscope, make a selection, appoint a worthy guardian, and get him to tell you what, when, how, or where to buy.

MICROSCOPICAL SOCIETIES.

IRON CITY SOCIETY, PITTSBURGH, PA.—J. Gordon Ogden, *Rep't'r.*

Tuesday evening, April 14, 1891.—The paper of the evening was on "Bacteria" by Dr. E. G. Matson, and the subject was exhaustively treated. The best modes of cultivating the different kinds of Bacteria were discussed and practically illustrated. The paper was listened to by a very large audience.

At the December meeting of the Society a paper on the "Cray-Fish," illustrated with many drawings and specimens, was read by J. Gordon Ogden, Ph. D. At the March meeting Prof. F. C. Phillips read a paper entitled "Some Recent Problems in Water Supply." The paper was based upon experiments made by Prof. Phillips in the rivers near Pittsburgh, and proved that most of the nitrogenous matter from the sewage of the cities of Pittsburgh and Allegheny was oxidized before it reached a point six miles below the cities.

The membership of the Society has been increasing rapidly, and through a recent purchase from Mr. C. C. Mellor we have now one of the finest libraries on Microscopy and allied sciences to be found in the country.

NEWTON NATURAL HISTORY SOCIETY.—W. D. GRIER, *Reporter*.

January 5, 1891.—Mr. Frank A. Bates, of Boston, delivered a lecture on "The Wing Anatomy of Rhopalocera." He prefaced his lecture with a brief account of the life-history of a butterfly, tracing it from the egg to the imago, or perfect insect, capable of reproducing its kind. He then described the general anatomy of the wing and its development, and the many colored scales with which it is covered. Mr. Bates stated that in the course of his investigations on the subject (during which he examined a large number of butterflies), he observed that the scales increased in development toward a complex form as they neared the centre of vibration and decreased as they receded from it.

He also described the gradual change from hair to scale, observed in the body and wing of the insect, and the difference in shape between scales from different butterflies and from different parts of the same butterfly.

He described the peculiar "battledore" scale of the common cabbage butterfly (*P. rapæ*), which he said he only found upon a limited area near the disc, upon the upper surface of the anterior wings, and also a scale from a Japanese butterfly, which was chiefly remarkable from its large size and peculiar striation. The paper was well illustrated with the lantern and views, some of which were drawn upon glass by the lecturer. There was also an exhibition of lantern views of the White Mountains and Antilles, and some miscellaneous slides of insect anatomy, etc.

NOTICES OF BOOKS.

Open Sesame. By Blanche Wilder Bellamy and Maud Wilder Goodwin. Ginn & Co., Boston, 1891, 12°, pp. 361, 3 plates.

The Open Sesame is a collection of well-chosen selections representing many phases of literature, dramatic and narrative, epic and lyric, political and domestic.

Such books as the present series, of which this is the third number, have their place in the field of literature, and accomplish much good.

Placing before the youthful mind the cream of poetry and eloquence, they inspire a love for literature and invigorate the memory by storing it with the pleasing facts of history.

The present volume, which is especially arranged for students over fourteen years old, is one of the best books of its class we have yet seen.

Insecta. By Alpheus Hyatt and J. M. Ames. D. C. Heath & Co., Boston, 1890. 300 pp., 223 figures.

This guide is a series of replies to questions which have arisen in the minds of its authors while teaching, and many of the answers are given as quotations from other observers. Entomology is a science of observation by no means exhausted. Indeed, the accumulations of experience do not yet amount to certainty, and the authors recognize that their definitions and conclusions may be subject to correction.

The guide begins with a discussion of Insecta in general, and proceeds to the method of classification adopted by the authors, giving sixteen distinct orders. Some teachers may be loath to accept the in-

troduction of sixteen separate orders of insects, but if they investigate the claims of the present volume they will find that in this manner they can obtain clearer ideas of the relations of the different orders than by following older, although apparently less complicated classifications.

Appleton's School Physics. By John D. Quackenbos, M. D., assisted by A. M. Mayer, Ph. D., F. E. Nipher, A. M., S. W. Holman, S. B., and F. B. Crocker, E. M. American Book Co., 806 Broadway, New York, 1891. 12°, pp. 544, 408 figures.

The editor in this valuable work on Natural Philosophy has borne in mind the present demand for a text-book of the most advanced and practical laboratory and pedagogical methods to be used in the higher grades of high schools and academies.

Believing that special investigators and teachers are peculiarly qualified to represent their own branches of science, he has selected men of recognized eminence and skill as assistants. The reputation of the several contributors and the standing of the scientific schools which they represent will secure for this work a prompt consideration and early introduction to the best educational institutions.

Attention is called to the thorough and original treatment of motion, energy, and force, to the teaching not only of results but what practical use can be made of them, to questions for exercising the reasoning faculties of the pupil and directions for simple experiments with home-made appliances, but to us and to our readers the treatment of the microscope is of especial interest, as shown by the following quotations:

"**The Compound Microscope** is an instrument designed to produce magnified images of objects too small to be seen with the naked eye. In the figure, the object *a* is placed just outside the principal focus of a lens or combination of lenses, O, and a real magnified and inverted image *b c* is formed. This image is then itself magnified at B C by means of a simple microscope, E, called the eye-lens. The latter is usually mounted in a sliding tube so that it can be properly placed with respect to the image. The lens and tube together constitute *the eye-piece.* If the magnifying power of O is fifty, and that of E four, the image will be two hundred times the size of life.

"Chromatic aberration in the microscope is corrected by using a concave lens in combination with the object-lens O.

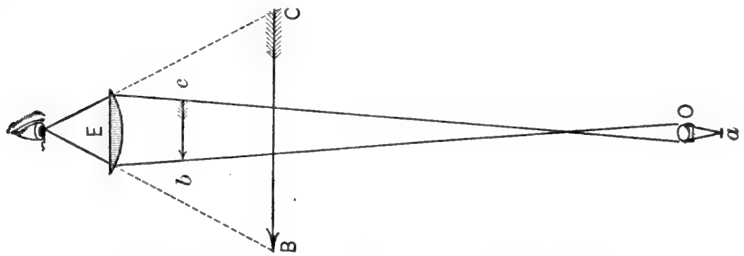

DIAGRAM ILLUSTRATING ACTION OF THE COMPOUND MICROSCOPE.

"As in the case of the photo-micrographic camera, the microscope may be combined with the stereopticon, and illustrations of minute objects thrown upon a screen for the instruction of an audience. The

electric light is now generally used for illumination, and the instrument is therefore known as the photo-electric microscope" (p. 354.)

"**The relation between the Microscope and Telescope** may be impressively illustrated by the pupil with the following simple apparatus:

"In the figure, S represents a screen of card-board, through which a cross, with arms about half an inch long, has been cut. This cross is illuminated by a gas-jet L. O is a lens (a large pocket lens will answer), which is placed eight or ten feet from S, and produces an image of the luminous cross upon a screen S′. Mark the dimensions of the image in pencil, and cut it through the card. E is a lens so placed that the card S′ is distinctly seen through it. Now remove S′ and look through the two lenses at the card S. This arrangement constitutes a telescope.

"Next let the flame and the eye-lens E change places. Focus the eye-lens on S. The image of the luminous cross in S′ is now represented by the cross in S. Remove S and look at the screen S′. This arrangement is a microscope.

ILLUSTRATING THE RELATION BETWEEN MICROSCOPE AND TELESCOPE.

"The focal length of the objective of a microscope is usually very short compared with that of the telescope objective" (p. 357).

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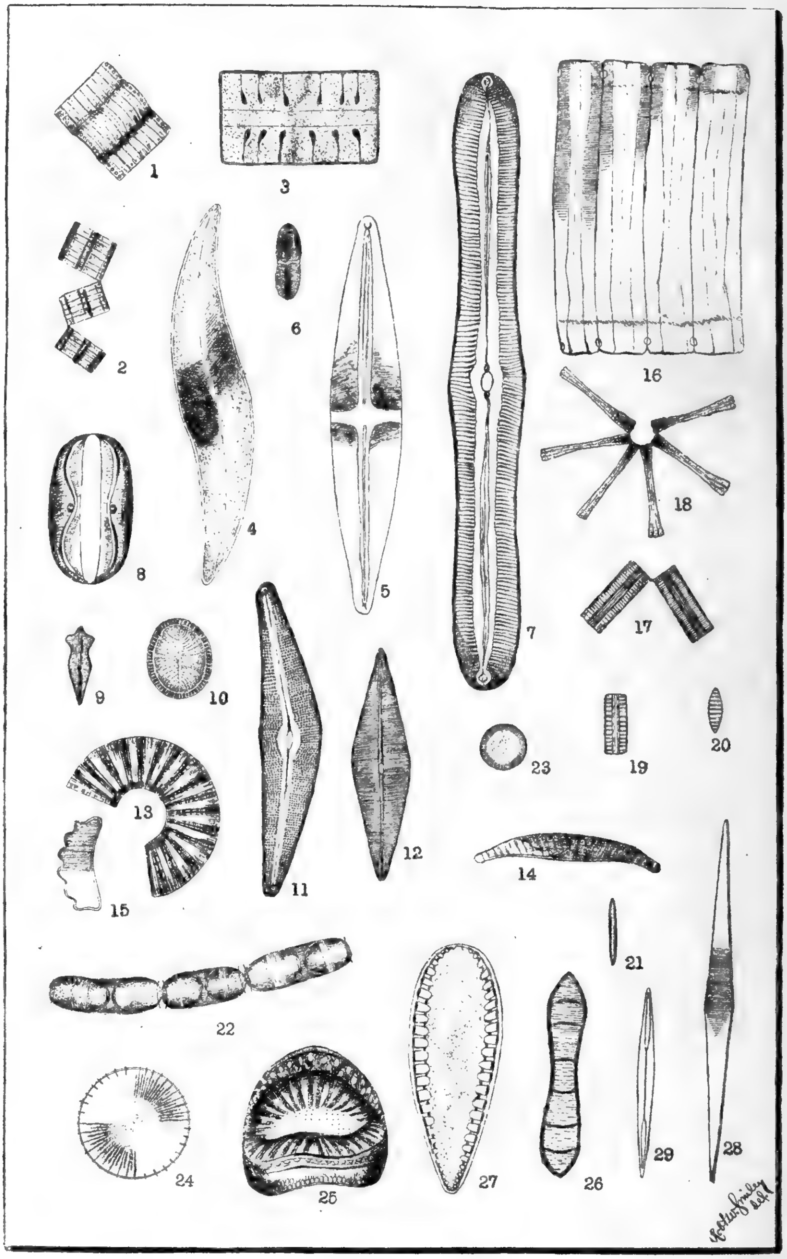

DIATOMS.—*Plate I.*

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Diatoms: Their Life History and their Classification.

BY REV. FRED'K B. CARTER,

MONTCLAIR, N. J.

[WITH FRONTISPIECE.]

(*Continued from page 85.*)

We come now to the last point, *how to tell to what genus a given diatom belongs*, and my answer is, by not attempting too much at once, but attacking the classification in sections. Diatoms, like desmids, are unicellular algæ. But unlike the desmids, they are salt-water as well as fresh-water plants. No desmids are found in salt water. Nearly as many genera of diatoms are found in salt water as in fresh. Others are both fresh-water and marine, and still others are only found fossil. Let us suppose, therefore, that a person wishes to know the forms he meets with in his gatherings from the ponds and ditches. In that case the fossil and the exclusively marine forms may be disregarded by him. Now, this simplifies the matter very much. For example, in the micrographic (which, for the same reason as was given in regard to the Rhizopods, we follow in preference to any later system of classification) there are over 100 genera of diatoms enumerated, or about five

LIST OF FIGURES IN THE FRONTISPIECE.

times as many as in the case of the desmids. That alone is enough to frighten the beginner, especially if he has already attacked the desmids and discovered that their classification was quite a study. But a glance through the list shows that a number of the genera are fossil and others marine. He rules out then, we will say, the fossil forms, and at once cuts the number of genera down to about 90, and then he throws out all those that are exclusively marine, or marine and fossil, and again the number goes down rapidly—to about 50. Here, then, are 50 or more genera which the student who searches the fresh-water ponds and ditches need not bother his head about, for he will not find one of them. And yet I venture to say that almost every beginner goes astray on this point. Why? Because he has a slide or two of diatoms of *Isthmia*, or *Arachnoidiscus* or *Triceratium*, and he starts off for his pool expecting to light on some of these. Yet he may search all his life without finding one of them in fresh water. The first thing then for him to learn is this: Which are the fresh water forms?

Well, let us look at the list and familiarize ourselves with their names. *Epithemia*, *Eunotia*, *Himantidium*, *Meridion*, *Diatoma*, *Asterionella*, *Fragilaria*, *Denticula*, *Odontidium*, *Cyclotella*, *Melosira*, *Stephanodiscus*, *Campylodiscus*, *Nitzschia*, *Cymatopleura*, *Surirella*, *Synedra*, *Amphipleura*, *Cocconeis*, *Achnanthes*, *Cocconema*, *Gomphonema*, *Navicula*, *Pleurosigma*, *Pinnularia*, *Stauroneis*, *Amphora*, *Tetracyclus*, *Tabellaria*, *Terpsinœ*, *Mastogloia*, *Schizonema*, *Encyonema*, *Frustulia*.

There are 9 others, but we may omit them as being unusual or synonymous, namely: *Oncosphenia*, *Sphenosira*, *Diadesmis*, *Perizonium*, *Sphenella* (= *Gomphonema*), *Achnanthidium* (= *Achnanthes*), *Cymbella* (= *Cocconema*), *Staurosigma* (= *Stauroneis*), *Colletonema* (= *Schizonema*). And we have as the result but 34 genera to distinguish; quite a practicable number as compared with over 100.

And further, four of these may be recognized by the gelatinous frond in which they are imbedded, namely: *Mastogloia*, *Frustulia*, *Schizonema*, and *Encyonema*. If the frond has little cushions for the frustules it is the first; if it is shapeless, the second; tubular, the third or fourth, and if the valve is bowed or bent it is the latter.

Again, of the 30 genera left, which have no frond, 3 more may be quickly disposed of, namely, *Tetracyclus*, *Tabellaria*, and *Terpsinœ;* for they all have heavy dark lines on the connected frustules. In *Terpsinœ* the lines have heads resembling notes in music. In both *Tetracyclus* and *Tabellaria* the lines run *lengthwise* of the filament; but *Tetracyclus* has the frustules connected all along the sides, *Tabellaria* usually only at the corners, forming a zigzag chain. It is true this is the description of the *front* view, but that is what the student will be likely to see, as they usually form a series.

Thus we have but 27 genera to study, which are divided into two main classes, distinguished by the presence or absence of a nodule or knob in the centre of the raphé or middle line of the valve. Let us take, first, the division with the nodule, as it is the smaller. Here are 9 genera. Look at your diatom, therefore, and if it has the nodule it is one of these: *Cocconeis*, *Achnanthes*, *Cocconema*, *Gomphonema*, *Navicula*, *Pleurosigma*, *Pinnularia*, *Stauroneis*, *Amphora*. And

these are the several characteristics: *Pleurosigma* is curved like an S; *Stauroneis* has a cross-bar on both valves, *Achnanthes* only on one. In *Pinnularia* the cross-lines resemble the teeth of a comb; *Amphora* is inflated, and the frustule usually shows two knobs in the middle of the flat side; *Gomphonema* is wedge-shaped; *Cocconeis* is elliptical, and very broad for its length; *Cocconema* is bent; *Navicula* has acute ends, no cross-bar, and the lines are resolvable into dots; *Cocconema* = *Cymbella* with a stalk, and *Achnanthidium* = *Achnanthes* without a stalk.

But suppose your diatom has no nodule. If so, it belongs to the other division, which includes the following 18 genera: *Epithemia*, *Eunotia*, *Himantidium*, *Meridion*, *Diatoma*, *Asterionella*, *Fragilaria*, *Denticula*, *Odontidium*, *Cyclotella*, *Melosira*, *Stephanodiscus*, *Campylodiscus*, *Surirella*, *Cymatopleura*, *Nitzschia*, *Amphipleura*, *Synedra*. Of these *Meridion* can be readily told by the spiral form of its united frustules. Now, as to the rest:

Is your diatom shaped like a *bow?* It is *Epithemia*, *Eunotia*, of *Himantidium*. If it is ribbed it is the first; if it has knobs at the ends, the second; if the frustules form a filament, the third.

Is it *rectangular* in *front view*, and are several of the frustules connected? It is either *Fragilaria*, *Odontidium*, *Diatoma*, or *Asterionella*. *Fragilaria* forms a straight filament; *Diatoma* a zigzag chain; *Asterionella* a star; in *Odontidium* the filament has a slightly uneven outline; in *Denticula* usually only two frustules are united.

Is your diatom *disk-shaped?* It is either *Cyclotella*, *Melosira*, or *Stephanodiscus*. And if it forms a filament of jointed cylinders, it is the second, while a fringe of little teeth will make it the third.

Are the *margins odd?* It is either *Campylodiscus*, *Surirella*, or *Cymatopleura*. If the frustule is twisted, it is the first; if the valve has a longitudinal line, it is the second; dark bands on the valve distinguish the third.

Finally, is it *very long in proportion to its width?* It is either *Nitzschia*, *Synedra*, or *Amphipleura*. If the longitudinal line is not in the middle, it is the first; if the sides are nearly parallel, the second; if the longitudinal line has terminal expansions, the sides of which are parallel, it is the third.

Or the beginner may start equally well with the *fossil* forms, if he has suitable slides for study. In that case he will have but 25 genera, and even 5 of these may be passed over as being classed as doubtful or obscure by the Micrographic, namely: *Amphicampa*, *Amphipentas*, *Mastogonia*, *Symbolophora*, and *Stephanogonia*. Divide the rest thus: *Breast-shaped—Hercotheca*, *Goniothecium: Heavy lines or seams—Bibldrium*, *Stylobiblium*: *Disk-shaped—Actinocyclus*, *Actinoptychus*, *Heliopelta*, *Coscinodiscus*, *Arachnoidiscus*, *Asterolampra*, *Asteromphalos*, *Halionyx*, *Odontodiscus*, *Omphalopelta*, *Systephania: with appendages—Eupodiscus*, *Auliscus*, *Hemiaulus*, *Periptera*, *Dicladia*.

Certainly, thus divided, this is no longer a formidable list, and you notice that you are dealing with forms quite distinct from those of fresh water. Those were mainly *long* forms; these are chiefly *round*.

In the first division marginal hairs distinguish *Hercotheca*.

In the second, *Stylobiblium* is round, and the lines form zones, in

Biblarium, a ladder. In the fourth, *Periptera* has circular valves and marginal horns or spines; *Dicladia*, two horns *within* the margin; *Hemiaulus*, two marginal horns and the valves not circular; *Eupodiscus* and *Auliscus* have short horns or knobs, and the latter is sculptured. *Aulacodiscus* is classed with *Eupodiscus* by the *micrographic*. The characteristic is the furrow connecting the process with the centre of the valve.

In the third division the valves are circular and marked with small dots or pits.

If there are no rays it is *Coscinodiscus*,, *Odontodiscus*, or *Systephania*. Teeth within the margin will make the third; on the margin, the second.

Or rays being present, it is one of these eight: *Actinocyclus*, *Actinoptychus*, *Arachnoidiscus*, *Asterolampra*, *Asteromphalos*, *Halionyx*, *Omphalopelta*, or *Heliopelta*.

You cannot mistake *Arachnoidiscus;* it is a spider's web. *Omphalopelta* has teeth within the rays. In *Actinocyclus* some of the radiating single or double lines are not continuous.

Is the surface wavy?

It is *Actinoptychus* or *Heliopelta*, and teeth all around the margin will make it the second.

And so you have left these three: *Asterolampra*, *Asteromphalos*, *Halionyx*. If the rays suggest a star it is either the first or the second, and if the star is perfect it is the first. In *Halionyx* the rays start from a transparent star or a ring of shorter rays.

Or again the student may take the marine forms. Here are 42 genera, from which he may omit 12, namely: *Cymatosira*, *Doryphora*, (=*Raphoneis*), *Pleurodesmium* (obscure), *Hyalosira* (probably =Tetracyclus, Micrographic), *Diatomella* (=*Grammatophora*, Micrographic, though H. L. S. retains it, *Lithodesmium* (doubtful), *Insilella* (= a rubbed or worn *Biddulphia*), *Corinna*, *Dickieia*, and *Syncyclia*, (not given by Smith), *Rhaphidogloea* (=*Amphipleura*), and *Micromega* (=*Schizonema*).

This leaves 30 genera, which may be ranged under these five divisions:

Frond—Berkeleya, *Homeocladia*.

Nodule—Cymbosira, *Toxonidia*, *Amphiprora*.

No Nodule—Eucampia, *Plagiogramma*, *Podosira*, *Pododiscus*, *Pyxidicula*, *Bacillaria*, *Podocystis*, *Tryblionella*, *Raphoneis*.

Heavy Lines or seams—Licimophora, *Podosphenia*, *Rhipidophora*, *Climacosphenia*, *Striatella*, *Rhabdonema*, *Anaulus*, *Grammatophora*.

Processes or inflated Angles—Biddulphia Isthmia, *Amphitetras*, *Chætoceros*, *Rhizoselenia*, *Syringidium*, *Triceratium*, *Syndendrium*.

In the first division *Berkeleya* has a frond rounded at the base.

In the second *Cymbosira* has a bowed frustule, and the frustules are connected endwise by stalks. *Toxonidea* has a bowed median line, *Amphiprora* has winged valves and is constricted in front view.

In the third, the frustules of *Eucampia* form an arched band, those of *Bacillaria* a series of rods. *Plagiogramma* has blank spaces at the middle and the ends of the valves. *Podosira* has the frustules connected by stalks from the *centre* of the valves. *Pododiscus* has a *marginal*

stalk. *Podocystis* is pear-shaped with a middle line. The valve of *Pyxidicula* is circular and very convex. *Tryblionella* has a heavy inner marginal line. *Raphoneis* has ends produced.

In the fourth, if the frustule is wedge-shaped it is *Licmophora*, *Podosphenia*, *Rhipidophora* or *Climacosphenia*.

The frustules of the first form a fan; the single frustule of the third, with its long stalk, resembles a battledoor; *Climacosphenia* has compartments; *Podosphenia* has the ends indented, but no long stalk, and the frustules are not united. If the heavy lines are not arched but straight it is *Striatella*, *Rhabdonema*, or *Grammatophora*. Interrupted lines will make it the second, frustules in a zigzag chain the third. *Anaulus* has indentations at the sides which show in either view.

And in the last division *Chætoceros* has valves with two long spines or threads; *Rhizoselenia* very long valves with conical ends tipped with a spine; *Syndendrium*, several spines on one valve only; *Syringidium*, valves unlike and two horns on one valve, one on the other. The frustule of *Isthmia* is a rhomboid or trapezoid; that of *Biddulphia* and *Amphitetras* is quadrilateral, but the latter is flat, the former inflated. If the valve is triangular it is *Triceratium*, but *Triceratium* is sometimes quadrangular or even pentagonal. It is therefore hard at times to distinguish *Triceratium* from *Amphitetras*. The angles of *Triceratium* often have short horns or little teeth which may serve as a guide, and the frustules of *Amphitetras* form a zigzag chain.

Here, then, is an easy way of becoming acquainted in turn with the principal fresh-water fossil and marine forms of some 84 out of about 110 genera mentioned by the *Micrographic*, which, together with Macdonald's work on Water Analysis, I have taken as my guide, arranging the genera, however, somewhat differently, and picking out simply the salient points, for some of which I have also consulted Carpenter and Wolle's work.

[*To be continued.*]

Microscopy for Amateurs.

By T. CHARTERS WHITE,

QUEKETT CLUB.

[*Continued from page 91.*]

Marine Objects.—No field of research so abounds in objects worthy of attention as the sea-side, and here the student may make himself familiar with marine fauna and flora to any extent, for the rocks and the algæ will furnish him with a variety of diatoms to be studied in their living state, while on a calm warm day the surface of the sea will be found teeming with the embryonic forms of many of the crustacea. The rock caverns at spring tides will well repay the search for different kinds of sponges, and various species of the *Ascidia*. The collecting kit of the pond-hunter will suffice for many localities. In the rock pools, deep down, he will find treasures in the shape of forests of living *Polyzoa*, whose feathery forms he will soon learn to distinguish. If these are attached to loose fragments of rock or pebble, they may be transferred bodily to a jar of clean sea water, and will there live

sufficiently long to be examined. But they are very delicate creatures and do not brook confinement long without drooping. The jar recommended to be employed is such as used by confectioners for their sweets and fancy biscuits. In use it should be covered by a glass plate to check evaporation as much as possible, and if one growing frond of the green sea lettuce (*Ulva latissima*), attached to a clean stone, be put into the water, sufficient oxygen will be evolved by its growth to maintain the polyzoa in a tolerably healthy condition for some time. The jar should be placed where light can fall upon it freely, but it must not be exposed to *direct* sunlight, as the small bulk of water would be heated thereby, and anything above the normal temperature is prejudicial to the polyps. A needful piece of accessory apparatus is a fine muslin tow-net. It is made in the shape of a funnel, about one foot in diameter at its wide end, and securely attached to a ring of *brass* wire varnished with shellac; if an iron ring is used, it is apt to become rusty. This net may be either towed after a boat as it is rowed along, or it may be attached to a stick, and the surface of the water skimmed from the side of the boat. The wash of the boat at its stern often scatters those forms which had been attracted to the surface by the sun. Whichever plan be adopted, the net must be occasionally raised and drained, and then turned inside out in a pail of clean sea water, when its contents will be washed off ready for examination. In examining marine objects in sea water, always use a plate-glass stage, on the ordinary stage of a microscope, to protect the brasswork from the corroding action of sea salts. From pieces of glass cemented together securely with marine glue, construct any special tank necessary for the examination of the polyps. Beautiful and dazzing as the polyps are in their living actions, the student may desire to preserve the remembrance of them in their dead forms, and to put them up for his cabinet. Various plans have been suggested and tried. Thus some recommend a very dilute solution of osmic acid; this answers tolerably well, if most gradually introduced into the trough while the tentacles are expanded. It has, however, the drawback of slightly blackening the creatures. A weak solution of bichloride of mercury, of about two parts of the bichloride to one thousand parts of water, introduced in the same way, has been successful in the hands of some mounters; but the best results have been derived from the use of whiskey. A piece of glass tubing has been melted over a spirit lamp, and drawn to a capillary point; this has been broken off, so as to leave a very minute opening in it. If this tube be now filled with whiskey, and inserted by the side of the trough holding the expanded polyps, the spirit will trickle in very small drops down the side of the trough, and become so gradually diffused through the sea water that the polyps, becoming accustomed to its blissful influence, succumb to it, and forget to draw in their tentacles. In mounting these as permanent preparations, nothing succeeds so well for a preservative fluid as glycerine and camphor water, which answers for most marine objects.

Among the many interesting objects to be examined at the sea-side are those tiny shells known as *foraminifera*, from the number of foramina which pierce their walls. They may be found in their living state attached to marine algæ, or in the oozy beds of a rock pool at the lowest tides. It has been stated by some naturalists that they float on

the surface of a calm sea in sunny weather. In the aquarium they rise to a height of four inches from the bottom, and by means of their pseudopodia, as they cling to the front glass. They multiply very fast and could be collected in abundance from the sand. The foraminiferous shells collected at the sea-side, containing, as they do, the living animal, require cleaning; this is best done by boiling in strong potash solution, which dissolves the sarcode of the animals without injuring the shells; then, after repeated washings to clear away the alkali, they may be dried and picked out with a stiff bristle slightly moistened in the mouth; they may thus be transferred to the cell in which they are to be permanently mounted. As they require fixing to the bottom of the cell, and as gum solution is inadmissible in all dry mounts, the cell must be lightly painted with a varnish made of *genuine* asphaltum. For mounting the foraminifera on it, they merely require placing, and the temperature of the slide being slightly raised, the shells become, as it were, glued by their under surfaces to the slide by the thin layer of the asphaltum, without its flowing up and over their sides, which frequently occurs with other black varnishes. If the recent foraminifera are placed in a very weak solution of hydrochloric acid, the shells, which are composed of carbonate of lime, are dissolved away from the enclosed sarcodic body. This, after washing, may be stained and mounted in the glycerine and camphor-water mixture. The chalk of the cliffs abounds in these beautiful objects in fossil condition, together with the testæ of different varieties of entomostraca. These can be liberated by the chalk being brushed under water in a hand-basin, using a rather soft nail-brush, which, by the gradual disintegration of the chalk, the foraminifera are separated without much damage, and can be picked out of the detritus and mounted. Some clays abound in foraminifera, and may be separated by making the clay thoroughly hot and plunging it into water. Then by repeated washings clear away all the particles till the sediment, consisting of sand and shells, remains. They require after this a great deal of careful cleaning, even with the potash solution, to get them quite clean. This is a troublesome process, and one which the student, perhaps, may not care to follow out. To those who would make themselves familiar with these forms of microscopic life without the trouble entailed in the process just mentioned, the author would recommend a visit to the bins of some dealer in Turkey sponge, when he may probably be favored with a quart of the sand which drops from the sponges. The sand being sifted away through muslin sieves, will leave a choice residue of many forms of foraminifera, besides the small spines of *Spatangus* and the *Echinoidea* generally. The foraminifera may be picked out with the bristle, or sometimes this residue may be sprinkled on the top of some water; the heavier particles of sand sink to the bottom, and the shells containing air float on the surface, and may be skimmed off and dried.

By chipping flints, especially those of yellow color, the silicified outlines of foraminiferous shells, principally *Textularia*, may often be found associated with sponge spicules and gemmules, and the fossil sporangia of the desmidiaceæ, known as *Zanthidia*. To chip these flints they must be held on a solid block of iron, and struck with the sharp end of a hammer. If the blow brings off an irregular lump, the position of the flint must be changed, and a blow again given with the

hammer; this must be repeated until the plane of cleavage is discovered, when the flint will break off in flakes. These may be placed in glycerine and examined; those containing any organic remains of interest may be stored away in spirit till they are mounted in balsam. Unless the student can gain access to a lapidary's wheel and slice his flints, it is better to buy them ready mounted. Failing this, to examine such thin flakes as he can obtain by the above method.

English Societies.—As an ounce of help is worth more than a pound of pity, so the student is likely to gain an insight into the use of the microscope and the making of preparations more from that friendly gossip which always takes place when kindred spirits and congenial minds meet to talk over those subjects in which they take a common interest than by his own blunders. Many little difficulties may arise in his work which all the books ever written will be useless in enabling him to surmount, when half an hour's chat with one who has met and overcome the same trials will put him quickly on the right path.

First and foremost in the encouragement of microscopical research stands the Royal Microscopical Society. Meeting in its own rooms at King's College, London, this society offers its fellows, amongst many advantages, a bi-monthly journal, containing a full report of all the latest advances in microscopical research, both British and foreign, with notes and illustrations of all the most modern improvements and additions to their favorite instrument and its accessory apparatus; also a copious bibliography of all recent writings bearing on microscopical science. Nine meetings are held during the winter and spring months, at eight o'clock on the second Wednesday of each month, at which papers are read and objects and apparatus of interest exhibited.

It has a very complete and extensive library of books bearing upon every branch of microscopical work, freely accessible to the inquiring student for reference on the evenings of meeting under the assistance of an energetic and amiable librarian, who is both able and willing to point out and procure whatever works the student wishes to consult. There are two meetings in the session especially devoted to the exhibition of the latest objects of interest. These advantages, with the privilege of appending F. R. M. S. after your name, are acquired by the payment of two guineas as an annual subscription, with an entrance fee of two guineas the first year. This society alone is sufficient to meet all the wants of the young beginner in microscopical investigation; but there is another, the Quekett Microscopical Club. This meets at University College, in Gower street, on the second and fourth Fridays in every month throughout the year. The meeting on the second Friday has been called the "gossip" night; members take their microscopes and some objects of interest, which are exhibited, and their mode of preparation explained. These evenings are most instructive to the tyro, for, however backward he may be in his efforts to go forward, he will meet with kind and ready help. All will evince a friendly desire to put him on the right road. The fourth Friday is devoted to the reading of papers by the members, and discussion thereon. The club possesses a very complete library, the books from which the members are at liberty to take home to study. It also has a cabinet of objects, a certain number of which the members may borrow for ex-

amination at home. In addition to these advantages for study, out-door excursions for the collection of objects of natural history, botanical specimens, and infusoria take place every other Saturday afternoon during the summer months, and are generally accompanied by some of the veterans in the art of collecting and instructing. The club publishes an illustrated journal every quarter, containing the papers read, and their discussion. The subscription to this club is ten shillings per annum, and without entrance fee.

Other Objects.—The blow-fly's tongue has always been a favorite object whether fulfilling its mission as a test object for flatness of field of view, or simply on account of the beauty of its pseudo-tracheæ. The blow-fly affords pleasure in many ways; as furnishing dissections it is unsurpassed. Whether alive or dead it always affords interest, especially in its recently-hatched condition. Blow-flies come from what are known in the fishing world as "gentles," which, after enjoying a short existence in this state, enshroud themselves in a brown case, and await that season when, bursting their bonds, they issue as blow-flys. At this period of their lives they are neat and clean. Their internal viscera are free from all contamination of food, and readily take any stain applied. To obtain it in this state of cleanliness, the following plan must be adopted: A hole should be made in a tin biscuit box, and a piece of glass tubing about half an inch in internal diameter passed from this hole through a bung into a clean, dry, wide-mouthed bottle. The chrysalids of flies, together with the sand in which they are supplied, being put into the tin box, they hatch in time, and as they hatch, find their way into the glass bottle through the tube. Feed such a newly-hatched fly on syrup stained with cochineal, and on dissection the whole alimentary tract can be readily discerned by the color. It is at this age that it will be found easier to lay out the proboscis in the usually accepted style, while the wings under an air-pump will often expand into bladders, as imprisoned air separates the two surfaces when the pressure of the atmosphere is removed. While speaking of the air-pump it may be mentioned that insects may have their tracheal system injected with carmine stain if they are placed in it under the receiver, and the air alternately exhausted and let in, two or three times in succession. The air being drawn out of the tubes during the first process, the carmine runs in to supply its place during the second. If the insects are colorless and transparent, the color may be traced even up to the tips of the antennæ.

The *Demodex folliculorum* is a minute acarus, which derives considerable interest not only from its place of habitation, from which it can be easily procured, but also from the lively movements it exhibits when first captured. It varies in length from one-fiftieth of an inch to one-hundredth. If the black spots which often adorn the face of adolescence be squeezed, a little speck of fatty matter exudes; take this up with an oiled pin, and transfer it to a slide, on which has been placed a little castor-oil, and cover with a thin and therefore light glass cover. On slightly warming this, the fatty matter dissolves and clears up, showing the demodex in great activity. If the epithelial scales, which help to make up the bulk of the fatty matter, are not so abundant as to hide the acarid, the cover-glass may be cemented down, as the mite is too minute to be transferred to another slide.

Ciliary action in Mussel.—This is one of the most attractive phenomena. The mussel being opened, a fringe-like expansion of the mantle is seen spreading itself as a lining over the inside of each shell. A piece of this may be snipped of with the scissors and laid on the slide, with some of the fluid out of the shell. A cover-glass may be placed on it, when it may be examined. The cilia will be found in rapid vibration, becoming slower after a time, when the nature of the action can be more readily seen and followed.

Circulation in the Frog's foot.—This, like the last, always excites considerable interest wherever exhibited well. To do this the frog must be made as comfortable as circumstances permit, by being placed in a linen bag, kept wet and well supported by the piece of apparatus known as a frog-plate. If the frog is comfortable, it does not try to move its foot about, which would seriously interfere with the view. The leg must not be tied in the mouth of the bag too tightly, or the circulation will be stopped. Two threads tied around two adjoining toes must be so fastened to the pins of the frog-plate that the distended web may be over the aperture in the stage. If this tieing is done carefully and neatly, the web may lie evenly in the field; it will require an occasional moistening with cold water.

Circulation in the Characeæ and Anacharis may be observed by placing portions of these plants in a trough. The Characeæ are a family of aquatic plants which might be classed with the fresh-water algæ, did not their reproductive organs tend to lift them to a higher grade. They are properly known as "stoneworts" from the habit they exhibit, in common with many algæ, of attracting to themselves calcareous salts dissolved in the water they inhabit, and depositing it on their outer tissues. This occurs in some individuals to such an extent as to deprive them of that transparency which the microscopical observer wishes to utilize in studying the circulation of the sap. They may be found in many ponds which are exposed to plenty of sunlight, where they present the appearance of feathery whorls disposed at intervals around an elongated stem. At first sight it is hard to distinguish them from *Myriophyllum*, but on being landed with the hook on the collecting stick, it will be seen that in *Chara* the stem seems twisted, while in *Myriophyllum* it is straight. The circulation in *Chara* may be most easily seen in the terminal leaflets, which, being newer in growth, are likely to be free from incrustations. *Anacharis alsinastrum*, the leaves of which, when slightly yellow and older than the rest, show the circulatory movements of the protoplasmic contents of the cells, may be found in many ponds, although in many parts of the country it is disappearing. It is one of those plants which grow in water without being rooted, and in this way it keeps water containing infusoria and small animals in a healthy condition by reason of its evolving oxygen, and therefore capable of sustaining aquatic life. It thus serves the microscopist in a double capacity, affording him specimens in which circulation may be studied, and ministering to the wants of those minute animalcules which without it would die of suffocation. *Vallisneria* also exhibits the phenomenon of the circulation, but it needs splitting into two layers to see it well. There are many other vegetables possessing *hairs* in which this circulation may be seen. Should the circulation be languid or movement be entirely absent, by carrying the plant in a small bottle of

water in the pocket for an hour or two the dormant stream will wake up to activity.

It is often desirable in a mixed company to exhibit something pretty rather than scientific. Having carefully focused a plain slide on the stage of a microscope let some one look through the eye-piece while a drop of spirit of camphor is run on the slide. At first nothing is seen. The spirit of camphor when first put on does not show anything under a spot lens or a paraboloid, but as soon as the evaporation of the spirit causes the crystals to form they show up suddenly as a silvery efflorescence, which is both startling and beautiful. Nothing exhibits the capabilities of a good spot lens so well as this. Another experiment may also be exhibited, as an opaque object lighted by the bull's-eye condensing lens: place a drop of a solution of nitrate of silver in distilled water on the slide, and nicking a very small scrap of a bronze coin off with your penknife, wet this scrap with distilled water, and place it in the centre of the drop of silver solution. Immediately bright leaves of glistening silver dart out from the metal, forming not only an attractive object at the time, but one which may be mounted permanently. Crystallization is always watched with great interest, and is one of those subjects which the student should familiarize himself with, so that he may readily recognize the crystals of the various salts he may meet with in his investigation, always bearing in mind that outward influences modify shape in crystals as well as in animal life. Let him crystallize bichromate of potash from a plain aqueous solution on a slide and compare it with another having a little gum arabic dissolved in it, and he might mistake them for different salts. Let him modify the temperature, and he will detect a slight change; but the most amazing changes may be produced from a solution of hippuric acid in absolute alcohol; such changes that every slide showing a different aspect might be mistaken for a separate salt. Let the solution be warm, the dipping-rod and the slide warm. As soon as the solution touches the slide it diffuses itself and becomes like a transparent film. Soon the moisture of the atmosphere begins to liberate the force which keeps back crystallization, and the film is studded with round centres of commencing crystals. If now the slide be alternately warmed and cooled, a series of concentric circles will be formed round the primary dot; these increase until contact with adjoining systems meet, and crystallization ceases; if instead of letting these circles increase, a sudden accession of moisture be supplied, as by quickly breathing on the slide, then rays of crystals start out from the edges of the circles, and a series of stars of varying size are formed. If this is done, accompanied by a moderately high temperature, the crystals form spirally; a higher temperature melts them, and their power of recrystallizing is destroyed. Crystallization, under the influence of different gases, considerably modifies the result, while crystallization from an alcoholic solution in which arabin takes part will make the crystals take a form totally unlike any other, and capable of being examined as an opaque object. When it may be thought desirable to mount any of these crystals, castor oil forms a good preservative; balsam causes them to break up in a most unsightly manner.

There is, perhaps, no movement observable under the microscope to which the student should direct his attention more important than those movements of minute particles of matter which are known as Brownian

movements, from their being found by Dr. Robert Brown to be associated with all minute particles in suspension in a fluid, whether they be organic or inorganic in their nature. Nothing is more likely to lead the student astray than to see these movements and not be aware of their character, such as one would be led to imagine he had discovered living elements where only physical causes are at work. With a view to familiarize him with their appearance, it is only necessary to rub a little gamboge on a slide in some water, and on examining a thin layer of this with a quarter-inch objective the particles of gamboge will be seen dancing round each other all over the field of view. The late Stanley Jevons had a very pretty way of exhibiting these phenomena. A shallow trough was to be made by uniting two square cover-glasses by three of their edges, and a small quantity of *kaolin* mixed with water was to be placed in it and allowed to subside till the boundary line between the surface of the deposited *kaolin* and the water was well defined. If now a small drop of solution of soap be allowed to run down one side of the trough and spread itself gently and without disturbance over the surface of the *kaolin*, although no active movements of its particles will take place directly, yet, in a short time, the whole surface will be seen in a state of lively vibration, owing to the Brownian movements being set up by the slight addition to the specific gravity of the water due to the soap. The movements are not attributable to evaporation, because they may often be observed in closed cavities, but may be influenced by electrical conditions, and in this direction we must seek for their origin.

The Long Island College Hospital.—We have received the announcement of this Hospital for 1891, and desire to call attention to the following changes:

(1) The regular course of lectures will hereafter be six months in duration.

(2) Three courses of lectures will hereafter be required for graduation.

(3) Joshua M. Van Cott, jr., M. D., has been appointed Professor of Histology and Pathological Anatomy vice Frank Ferguson M. D., who has resigned.

(4) The medical class of the present year numbered 250; the graduating class 82.

(5) 20,830 patients were under treatment in the Hospital and dispensary during the year 1890.

Dr. Simpson, of Calcutta, has exhibited some cultivations on sterilized potatoes of organisms obtained from the water of Tolly's Nullah. In them were growths of *Aspergillus oidium* and *Penicillium*, which, to the naked eye, presented the appearance of a white fluffy down interspersed with green and blue spots and little dew-like drops of moisture. Distinct from these were other growths of a yellow, salmon, and brown color, which, under the microscope, proved to be groups of various kinds of *Bacteria*. These show what luxuriant growths of organisms could be got on sterilized potatoes, and how, by this simple method, students could study the *fungi* and *bacteria*, and could thus add to our knowledge of the *Thallophytes*, a group the importance of which, in the economy of Nature, is becoming more evident the more they are studied.

Heredity: Its Part in Organic Evolution.

By Prof. HENRY L. OSBORN,
HAMLINE, MINN.

By heredity is meant the transmission to its offspring by a parent of the power to grow into the parental image. Of the fact of heredity in some sense of the word there can be no doubt whatever. It is easy enough to demonstrate beyond any dispute that young animals grow into the likeness of their parents in virtue of the operation of some internal force which guides them in that direction. Thus, for example, the eggs of two species of Echinoderms will develop in the same glass of sea water where the surrounding influences, external to themselves, must be the same for each, and yet each follows with unerring step a predetermined path. Eggs of our domesticated fowls can be placed under the same conditions, as in an artificial incubator, or entrusted to that wonderful instinct resident in the natural incubator, but their similitude of environment does not turn the embryos aside from their predestined course. I have lately been watching the eggs of the salamander, and they are such delicate and helpless things that one would hardly think such feeble folk could be so true, and yet day by day they follow courses exactly similar to those gone through in their growth by similar or identical European forms and recorded by Von Baer as long ago as 1834. Such facts as these show that the environment does not produce the mature animal, but that the egg from its start contains a force which propels it in a definite direction and which we call heredity. The fact that a delicate bit of protoplasm, the egg-cell, can hold its own among the contending forces in whose focus it is placed is the greatest miracle of nature.

But we must carefully remember that when we have referred the resemblance of a child to its parent to heredity as its cause that we have not really answered any question regarding the *vera causa* of the resemblance, for we have only given the inquirer a word, a name, and not anything more. Heredity, in fact, is one of the fundamental properties of protoplasm which no one has as yet succeeded in reducing to simpler terms. We say, if we use the language of Professor Huxley, that living things are unique among other things in undergoing "cyclical changes." Having noted what we mean by heredity, we must note in the second place that animals at large present grades of resemblance less close perhaps than that customarily observed between parent and offspring, and yet a structural resemblance which has not escaped observers from a very early date in the history of nature-study. Attempts at classification of animals or plants are based upon these resemblances. At first the question into the meaning of these resemblances was not thought of, but later it arose and has been answered in only two ways. By one school of philosopical biologists the resemblances were understood as indications that the animals were as one might not irreverently say made to order, and made by varying a few patterns a little this way or that. This conception was that which Prof. Louis Agassiz ably defended in his Essay on Classification. Its failure to account for many of the facts of embryology and comparative anatomy led it to be rejected by most biologists. By the other school of biologists the resemblances were understood to indicate more or less remote actual genetic

relationship or kinship between animals presenting them. Thus the red and grey squirrels by the Agassizian school resemble each other more than either does the gopher, merely because they were made by their maker as modification of one plan in his mind, while their resemblance appears to the other school to indicate a comparatively close actual kinship.

The latter conception is the Darwinian view; it extends the operation of descent, which is a natural phenomenon, never having been called in question by any thinkers so long as its operation is confined to the relationship in one "species," to the entire range of animals and plants. The Darwinian view of the meaning of classification, then, is that resemblances between living things really indicate, as they seem to, a kinship. Heredity is thus a conservative factor if its range is thus extended and tends to keep animals alike down to very remote generations. Heredity may then account for the likeness among animals widely remote in their relationship, as, for instance, fishes, reptiles, birds, and mammals, but, as we have considered it thus far, will it account for their differences? We may note in the third place that the differences between animals might conceivably be due to the interaction between the inherent and hereditary tendency and the environment of the animal. The French zoölogist Lamark was acute enough to think of this, and he proposed to explain the order of the animal and plant worlds upon the two assumptions that the use of organs modifies their structure, and that parents transmit this modification of structure as well as their general race type of structure. His theory attracted but little attention at the time. Unfortunately for Lamark's theory there are very few facts which go to prove that modifications of structure acquired during the lifetime of an individual can be transmitted by heredity. Modifications of structure which appear "congenitally," as it is termed, that is, those which are, so to speak, born in an individual so that they are independent of the animal's environment, are well known to be transmissible. Thus, for example, a cat born tail-less or six-toed would be likely to transmit the peculiarity to its offspring, but one who had lost a tail or gained a toe by accident during adult life would be almost certain not to transmit the peculiarity. Lamark's proposition is therefore not obviously true to facts.

Before going further, I may now call attention to the importance for clearness of distinguishing modifications of structure which have been the direct result of the use of organs called acquired characters and modifications which have appeared in an individual independently of use, such as monstrosities for instance, or sports among plants, as well as hundreds of slight and hence unnoticed ones which are called "congenital variations." Heredity is admitted by about all writers to include the parental type and any congenital variations.

Darwin, in his theory of organic evolution, sought to account for the varied forms of animals and plants as the outcome of transmission of race type and congenital variations with the supplementary effect of crowding, which would cause a natural selection of the best for breeding, the poorest having succumbed in the contest for life. This theory left too much to the element of chance in accounting for the appearance of favorable congenital variations at the critical time, and Prof. E. D. Cope, whose studies had been chiefly among the osteological features of verte-

brates, proposed to supplement Darwin's hypotheses of the "survival of the fittest" by accounting for the "origin of the fittest." He revived the Lamarkian view that the acquired characters are transmissible, and considers it the chief factor in organic evolution. An extension of Darwin's view was seen to be necessary by its astute author, and he repeatedly stated, in language now seized upon by Cope and his compeers, that he only called the variations naturally selected on the terms of his theory "chance variations," because he did not know how they were produced, and that acquired characters might to some slight extent be transmissible. Darwin's view presents an immense advantage over its former rival, the view of the elder Agassiz, in the way it harmonizes a vast body of biological data in all departments, no rational interpretation of which has, so far as I know, ever been attempted upon the other view.

The hypothesis of evolution can hardly be said to have gotten upon any very solid advance ground since Darwin left it. It is now much better understood and in its main features accepted by nearly all biologists. But two violently hostile schools have grown out of the effort to deal with the cause of diversity among living things. One school, the Darwinian, numbers Lankester and Weismann among its leaders and insists that no "acquired characters" are proven to be transmitted; and so far as facts have been positively gathered it must be confessed that they are in their favor. The "Neo-Lamarkians" do not, however, give up the fight, and in spite of their inability to produce any actual, indisputable cases of the transmission of acquired characters, they collect the evidence from lives of creatures apparently evolved and find no adequate explanation of the progression of structure they exhibit, except on the assumption that function so reacts on the organism, though in an unexplained way, as to add to the sum of tendencies to be transmitted the tendency to inherit the acquired structure. The question thus becomes really an inquiry into the nature of heredity. My statement of the case at the beginning of this article is intentionally vague, for it leaves undefined the term "parental image." The progress of the article I think shows that we cannot yet say what this transmissible image is. How far is it the race type, how far the individual image? Is it the image of the ever-changing parent at the instance of the egg's first start on its course to independence or at some previous time? Is it a partial product of the diverse tendencies of both parents? Not one of these questions can be answered. While thus the general proposition of evolution as the result of survival of the fittest is virtually settled the further question of the origin of the fittest still awaits solution.

HAMLINE UNIVERSITY, *April* 25, 1891.

Causation of Influenza.—The germs of influenza are generally, at all times, present, and the germs of pneumonia, tuberculosis, and of the other specific diseases are somewhat widely disseminated; but there must be certain coincident meteorological conditions to irritate the throat and air-passages sufficiently to let the germs gain an entrance to the body. These meteorological conditions are at times the excessive prevalence of north and northeast winds, and the excessive amount of ozone during certain months.

On the Occurrence in the Fresh-waters of Calcutta of Reticulated Amœba.

By W. J. SIMMONS,

CALCUTTA, INDIA.

The organism probably identical with *Biomyxa vagans*, Leidy, from the fresh-waters of North America, consists of a glairy, colorless, and finely granular protoplasm, similar to that observable in *Amœbæ* and other Rhizopods. In *Biomyxa* this protoplasm exhibits a marked tendency to bipolarity, that is to say, its pseudopodia, as the extensions of its bodily substance which subserve locomotion are called, are extended from opposite poles as fine threads, which anastomose with one another so as to form an irregular network with knot-like expansions at the points of intersection of the threads, which expansions are comparable in all respects, save size, to the main mass. The organism changes in form from moment to moment, when in full activity. Mr. Wood-Mason had suggested to me that the nucleus, which the writer had not detected, might have been left behind in the web of the pseudopodial network, or more probably been concealed by the granules and ingested food particles. Along the glassy threads of this network solitary or associated granules course at a rate which, when most active, exceeds that of cyclosis, as observable in such a plant as *Vallisneria*, the flow being in opposite directions on the two margins of the filaments; while fusiform particles of protoplasm glide down the pseudopodia like rain-drops along an inclined telegraph wire. Minute vacuoles present themselves both in the main mass of the organism and in the knot-like expansions of the pseudopodial filaments. There is no visible distinction between the exoplasm and the endoplasm. Three or four diatoms (*Cocconeis*, Sp.) were seen to be imbedded in the main mass of the protoplasm, and several *Flagellata* were being towed along the pseudopodia, their flagella having apparently been caught in the current of protoplasm flowing in the reticulated filaments. Some *Bacteria* were also observed, and it seemed obvious that they too were being swept along owing to their flagella adhering to the protoplasm in the filaments. The organism is doubtless identical with Leidy's *Biomyxa vagans*. It was found amidst the debris of a decaying leaflet of Anarcharis obtained from a bowl of water and weeds which was drawn from General's Tank on the 1st of February last, and has been under observation from that day onwards throughout the month of February, the specimen of *Biomyxa*, having been observed on the 22d idem. Four drawings were made with the aid of Beck's vertical camera. The first sketch was drawn about 9 o'clock; the second and third about noon, when the organism had attained its fullest development and activity; the last sketch was drawn a little after 4 o'clock, by which time the organism had shrunk considerably, and nodules of protoplasm had commenced to form themselves on the central body, while the flow of granular matter had become very feeble. Adopting the most recent classification, the systematic position of *Biomyxa*, according to Bütschli, would be: *Rhizopoda;* sub-order 1, *Amœbæa;* Family *Amœbæa reticulosa;* Genus *Biomyxa* (Leidy)—of which at present but one species had been found in the fresh-waters of North America, and, we must probably add, of India.

The presence or absence of a nucleus in these low forms of life is of considerable importance.

[J. Wood-Mason, commenting on there being no visible nucleus, said it was not remarkable, as only the one specimen had been found which had, perhaps, been too full of granules and food particles to permit of a nucleus being seen, if present; and moreover no reagents were used. It was impossible to say whether the organism was an animal or a vegetable until it had been observed throughout the cycle of its life-history. Might not the flagellated bodies have been the zoospores of the *Biomyxa* itself? One of the animals which had been placed originally among the *Amœbæ reticulosa* had recently been proved to be the amœba stage of one of the *Myxomycetes* (*Mycetozoa*). It was also at present quite uncertain whether this *Amœba* was a compound or a simple body, that is to say, whether it had resulted from the growth of a single primordial cell or from the fusion of many.]

Address of the Retiring President of the Washington Microscopical Society.

By Dr. THOMAS TAYLOR,

WASHINGTON, D. C.

[Abstract.]

At the close of each year, since its organization, the Microscopical Society of Washington has made an exhibit of work done by its members, frequently including work done by eminent men of other countries. To-night we meet for this same purpose.

It has also been customary for the retiring President of the Society to make a few remarks regarding the advance made in this branch of scientific inquiry, not only as regards the improvements in the instruments of precision used, but also, as regards important discoveries that may have been made by their use in the hands of skillful and patient investigators throughout the world.

The Microscopical Society of Washington will, I believe, compare favorably with any like society in the United States as regards the practical experience, scientific attainments, or natural gifts of its members. This society consists for the most part of men of various professions, such as professors of anatomy, physiology, pathology, therapeutics, chemistry, surgery, botany, bacteriology, and law. Our members are all enthusiasts in scientific work. Within the last ten years great progress has been made in microscopy.

Twenty years ago, when I entered upon my work in the United States Department of Agriculture, there was *not one microscope* in general use in the Department. To-day there are probably no less than thirty, and a like degree of progress may be safely assumed for the universities and colleges of this city. Nor is Washington alone in this march of progress: The universities, colleges, and Hatch Agricultural Experiment stations throughout the country are all engaged more or less in microscopical investigation.

Large establishments in the United States are now devoted to the manufacture of lenses and microscopes of superior quality.

The simple or single lens microscope has given way largely to the

compound microscope, the latter giving greater magnification and better definition. With our improved microscopes an object the one-hundredth of an inch in diameter appears a large object; an object the one-thousandth of an inch in diameter may be dissected, and a parasite the one-fifty-thousandth of an inch is easily detected under the cover-glass, and distinguished from other species by the use of chemical coloring reagents and other expedients. Dr. Goring, of England, who invented tests for the microscope many years ago, was able with his lenses to get the lines of *podura* with wonderful perfection. Dr. Royston-Pigott wrote, in 1876, that when he was a young medical student it used to be thought the highest point of microscopical skill to be able to take a little diatom, the *hippocampus*, and with a ray of oblique light get its transverse lines, which, on turning the light the other way, disappeared and were replaced by other lines running in a longitudinal direction.

In 1845 the diatom *hippocampus* was viewed as a line object and the lenses capable of showing these lines were highly approved. Then there was a contention that they were not lines but series of hexagons, and the late Col. Woodward, who, by using the blue rays alone, was able to photograph the most delicate appearances of microscopic objects, succeeded in resolving the so-called lines of *hippocampus* into what appeared to be series of spherules or beads. The next photograph obtained by Col. Woodward was the very difficult one of *angulatum*, the lines of which it was believed he also resolved into beads.

The members of our society will doubtless recollect that, about a year ago, the *Journal of the Royal Microscopical Society* in its summary of current researches relating to microscopy had the following:

"At the March meeting of the society a photograph by Dr. Van Heurck (director of the Jardin Botanique, Antwerp) was exhibited of *P. angulatum*, produced with Zeiss's apochromatic objective of 1.63 N. A. The note accompanying the photograph was as follows: 'I have the honor to submit to the Royal Microscopical Society a photograph of *P. angulatum* made with the objective of 1.63 N. A., using strictly axial illumination. The fracture of the upper edge shows clearly that the 'beads' are holes in the intermediate layer, and that the form of these holes (beads) is hexagonal, as maintained by Mr. Smith and myself. The form of the small bar on the extreme top, which is the part of the negative focused, shows that the 'beads' can not be round.'"

The next stage of advance in the microscope was to resolve the *podura* scale into little tongues, as it were; and these little marks are still used by opticians as test objects. This object was most beautifully photographed by Col. Woodward in lines. The next stage in the direction of microscopical development was to cut off useless rays of light and leave the most useful ones which were found to define the object.

Drs. Drysdale and Dallinger (names forever noted in the use of the microscope for physiological research) used the highest power (at that time one-fiftieth of an inch). This is a very delicate objective to use, and the result of their beautiful contrivance was this: they found that in a given field where ordinary power and an ordinary microscope discovered not the least sign of animal life, even of the minutest form, there were myriads of little monads turning and switching their tails about like long whips under this remarkable power, and it is believed that all conclusions founded upon the non-appearance of animalcules in a given

fluid as seen by microscopes of very great cost and power fall to the ground unless these peculiar methods are adopted which were then invented. Drs. Drysdale and Dallinger not only limited the amount of light, but they fixed a lamp upon a bar on which is placed a mechanical solid rest, by means of which the lamp is brought to one particular position within the 100th of an inch, and out of many positions in which the lamp is placed to get a particular ray of light they found one ray in one particular direction which gave the most superb definition, and in this way they were not only able to see these monads but to distinguish their forms and movements.

In the year 1884, the optical factory of Carl Zeiss, in Germany, first constructed, under the direction of the world-renowned Professor Abbe, of Germany, microscopic objectives of different kinds in which perfect correction of the spherical and chromatic aberration was effected by the use of lenses (one to three in each system) of *fluorite* instead of *crown glass*. The first experiments in this direction were made by Dr. Schott, in 1881, and showed clearly the extraordinary technical difficulties in the way of the production of sufficiently homogeneous glass of such a composition. Fluorite is simply the continental name for common fluor-spar. The most common color the mineral assumes is pale green, evident enough in large crystals, but in laminæ, thin as the lenses of an objective, scarcely, if at all, perceptible. Of the minerals which occur in nature, quartz and calc-spar are the only two which have been regularly used in practical optics. Their chief use depends on the specific optical properties not contained in common glass which they possess. Quite different points of view are now, however, kept under consideration in judging of optical resources for the continued improvement of the compound microscope. The estimation of the materials used in lens-combination has altered in direction; it has turned to the consideration of the degree in which the properties of these materials facilitate and advance the neutralization of the unavoidable subsidiary effects—spherical and chromatic aberration. Having regard to all the conditions which regulate the construction of a perfect lens-combination, the spherical aberration in systems of large aperture, as well as the chromatic aberrations of first and second orders, *fluor-spar* affords more profitable relations than any material at present available in optics. The data on which the present conclusions are based were made long ago by the spectroscopic measurements on fluor-spar which Stefan published in 1871, and those made by Dr. Riedel, of Jena, in the year 1880, and later, at Professor Abbe's instigation, with the use of hydrogen lines on different varieties of the mineral.

It is little more than a year since the microscopical world was thrilled by the announcement of an objective made at Jena, the numerical aperture of which is 1.63, the highest numerical aperture previously known being 1.52. Professor Abbe was four years in bringing this work to completion. The German government had offered to place a sum equivalent to $25,000 at the disposal of any one who would undertake to improve the then existing lenses, and Prof. Abbe, with indefatigable patience, has realized practically all that theory indicated as to the possibilities of the microscope since the discoveries of Goring.

The microscopical characteristics of the food fats have become a subject of much interest of late years. My attention was specially directed

to their crystallization in the summer of 1876. I had stored in a warm place a quantity of fresh country butter which of course became rancid. I endeavored in various ways to render it sweet and palatable, more from love of experiment than with a view to profit. I boiled a portion of this butter and allowed it to cool slowly. I then examined some of it with low powers by plain light and found it in a highly crystalline condition. This led me to examine other animal fats and compounds of fats, such as lard, oleomargarine, and butterine. My first paper on this subject was published in the *Scientific American* in 1879. During the same year Hitchcock and Wall published with illustrations my paper relating to my methods of detecting oleomargarine. I also brought the subject before the American Society of Microscopists, the American Association for the Advancement of Science, and about 1886 before the members of this society.

While much has been written on this subject in this country and in Europe, I consider that the knowledge we possess regarding the glycerides of the fatty acids is yet in its infancy. It was but yesterday that I discovered a new method of precipitating fish oil from linseed oil, thus rendering it possible to detect in a few seconds a fish oil when used as an adulterant of paint oils. The conditions under which this separation takes place are very curious indeed. In making the experiment I combine the linseed oil and the fish oil in any proportions desirable. To this I add an aqueous concentrated solution of nitrate of silver and mix all intimately by agitation. In a few minutes a large portion of the fish oil coagulates, while the linseed oil does not. The fish oil becomes so dense that it displaces the silver solution by falling to the bottom of the test-tube, exhibiting the remarkable phenomenon of a column of silver solution resting on a column of oil, while the linseed oil rests on the surface of the water solution, as might be expected.

The remainder of the address was devoted to an account of the methods of distinguishing between butter and oleomargarine, and lard and its compounds, and to an exhibition with the aid of Prof. Murray of a series of enlarged photographic views thrown on the screen by a calcium light, showing the distinctive appearances of various animal fats as seen through the microscope under polarized light.

U. S. DEPT. OF AGRICULTURE, *April* 21, 1891.

Medical Microscopy.

BY F. BLANCHARD, M. D.,
WASHINGTON, D. C.

The New York Pasteur Institute.—From the first annual report of this Institution we extract the following figures: 828 persons bitten by dogs came for treatment. In 643 of these cases it was proven that the animals which had attacked them were not mad, and the patients were dismissed, after proper treatment of their wounds. In 185 cases the attacking animals were shown to be suffering from hydrophobia, and anti-hydrophobic treatment was applied. No case of death from hydrophobia has yet been reported among those who were inoculated.

Differential Staining of Human Blood Corpuscles.—Have at hand two clean cover-glasses. Clean and cord the left forefinger, and prick it with an aseptic cambric needle. Breathe upon one cover-glass

and touch it to the drop of fresh blood, and immediately breathe upon the other cover-glass and lightly place it upon the first. Just enough moisture should adhere to the cover-glasses so that the blood will diffuse itself over the entire surface of both. Separate the two glasses by a sliding and circular motion. Allow them a few minutes to dry; then pass two or three times through an alcohol flame, and lay them with the coated side up upon a sheet of blotting-paper. With a drop-tube place two or three drops of eosin solution upon each glass, spreading it carefully over the whole surface; let it remain five minutes, then wash the glass by waving it in water. Place the glass again upon the blotting-paper, with the coated side uppermost, and with a hand bulb, such as dentists use to dry the cavity of the tooth, blow all the water from the surface. If the water is not removed at once, it will dissolve and diffuse the coloring matter and render the specimen worthless. Proceed in the same way with aniline blue. Let it remain five minutes, wash and dry in the same manner, and finally mount in balsam. If properly prepared, the specimen will show the red corpuscles colored a beautiful pink, and the white a pale blue or light purple with several dark-blue nuclei in each.—*F. A. Rogers, M. D., in the Microscope for March, 1891.*

Reports of the Postal Club Boxes.—XII.

By QUEEN MAB.

The publication of the Cole Studies having been discontinued, the managers of the American Postal Microscopical Club have invited the expert members of the Club to contribute a substitute, in the form of special boxes, accompanied by notes and illustrations of their own work. Already the responses received have been generous and attest the wisdom of the new departure. It was their availability which influenced the selection of the Cole Studies for circulation, and while the high character of work done in America will doubtless maintain the former standard, the fact that many of the new contributors are personally known to the members may add to the interest of their work and increase the usefulness of the Club. A copy of the last edition of Carpenter's work on the microscope will be cut up to accompany some of the slides, so that contributors can select the objects contributed with reference to illustrating any of the cuts or descriptions of that work.

Box D.—Among the objects of interest recently examined was a slide of ground black pepper adulterated with potato starch, which latter the polariscope brings out finely, by Mr. F. T. Aschman, of Sharon, Pa. The pepper was simply soaked in turpentine and mounted in balsam, and should be viewed with a ¼-inch objective, thus being a very simple object to prepare for examination. Indeed, this is one of the numerous objects whose study will profitably occupy any chance leisure moments. Mr. Aschman says that adulteration among the spices seems to be most common in black pepper, fully three-fourths of the samples which he has examined having been adulterated. The frequency of adulteration is shown by the fact that ground black pepper is cheaper than the whole grains of the same article. Potato starch, however, is rather of an unusual adulterant, ground crackers, beans, etc., being more frequently used. Mr. Aschman continues: "In this

connection I would like to say that we ought to agitate as much as possible for a national adulteration law. State laws for various reasons are dead letters, and moreover any State not very strict in its enforcement becomes the dumping-ground of all the adulterated stuff from States more vigilant. The amount we are out of pocket (to say nothing of really dangerous admixtures, and especially of diluted medicines, etc.) from this source alone must be enormous."

Prof. H. N. Conser, of New Berlin, Pa., contributes a slide of cerebellum of seal to the same box. This was hardened with chromic acid and alcohol, stained *in toto* with borax carmine, cut to 1-50 mm. on Jung microtome, and mounted in balsam.

Blood corpuscles of Newt, by Mr. H. M. Kelly, also of New Berlin, Pa., constitutes No. 3 of this box. It was prepared by Gage's method, mounted in glycerine with 1 per cent. glacial acetic acid, and should be examined with a ¼-inch objective. "The blood is allowed to drop into 6-10 per cent. salt solution; corpuscles will sink after a time. Fixed in picric acid and stained in picro-carmine."

Prof. Biscoe, of Marietta, Ohio, contributes a specimen of interstitial method of paraffin embedding in the form of a longitudinal section of head of blossom of marigold.

Mr. C. K. Wells, also of Marietta, contributes a specimen of Hydrozoa killed with corrosive sublimate, stained with borax carmine, embedded in paraffin, and cut with microtome.

In *Box M*, Prof. Bessey, of Lincoln, Nebreska, contributes slime mould, *Dictydium cernuum*, mounted in glycerine jelly, and for the non-botanical reader thus describes the object: "Slime moulds are among the lowest of plants. They are protophytes, and in many points show an evident relation to protozoa. The specimen shows the spore-bearing stage. Before spore bearing, the organism was a naked, amœba-like mass of protoplasm, endowed with a good deal of mobility."

Concerning another object whose description is very briefly given and which Dr. S. G. Shanks, with his usual painstaking accuracy has figured and described, a critic says: "All honor to Dr. Shanks who so kindly gives his time and knowledge to help those of us who are not versed in histological points of these slides. May he long live to help us out." The notes of such experts as Dr. Shanks add greatly to the work of the Club. Would that the number of such concise and instructive notes were greatly increased."

MICROSCOPICAL SOCIETIES.

WASHINGTON, D. C.—L. M. Mooers, *Secretary*.

Since the beginning of the year the meetings have been well attended and much interest has been manifested. The membership has been increased by the following new members, some of them well-known workers and specialists: Dr. H. L. E. Johnson, Dr. W. W. Alleger, Dr. C. W. Richardson, Dr. J. Foster Scott, Columbia Hospital; Mr. J. M. Stedman, Agricultural Department; Dr. Cooper Curtice, Agricultural Department; Mr. John Grinsted, Dr. Geo. H. Penrose, resident physician at the Soldiers' Home, and Mr. M. E. Schneider.

Some especially fine papers have been presented and discussed, among them the following:

January 20.—"Methods of demonstrating the presence of flagella on motile bacteria, with special reference to the staining processes," by Dr. V. A. Moore.

February 17.—"The nervous system of fresh-water sponges," by Mr. J. M. Stedman.

March 3.—Embryology of the Chick, illustrated by slides, by Mr. J. M. Stedman.

April 7.—Drawing microscopic objects by the use of co-ordinates, by Dr. Cooper Curtice. Also, by Mr. Stedman, a paper on the nervous system in the electric apparatus of the torpedo.

On April 21, occurred the seventh annual soiree of the society, which was one of the most successful that have been held in matter of arrangement and character of the exhibits.

May 12.—The society listened to a most interesting paper by Dr. Theobold Smith on "Some observations on the microscopic study of the blood."

NOTICES OF BOOKS.

The Soul of Man. By Dr. Paul Carus. Open Court Publishing Co., 1891. 480 pp., 152 cuts, $3.00.

In the Soul of Man Dr. Carus treats of the most salient psychological problems, presenting them in their connection with philosophy, physical science, including mechanics, physiology, hypnotism, religion, and ethics. Too many writers on psychology are given to metaphysical speculations, and so repel those who have prejudices of their own with reference to the problem of the human soul. This Dr. Carus has studiously avoided and has confined himself to arranging and systematizing facts. The statement of his position is made very clear and even pronounced, but the usefulness of the book is by no means restricted to those readers alone who will accept his views. The study of psychology is one of the broadest in the field of science, and, though much neglected, is rapidly gaining the prominence it deserves. The present volume, from the mere collection of material it contains, should find its way to all who are interested in the study, however widely their opinions may differ from those of the author.

A Chart of English Literature. By George E. Maclean, Ph. D. Ginn & Co., Boston. (Price 35c.)

Experience in the class-room has demonstrated the value of charts. Those who are contemplating a study of the history of English literature will find the present publication of great assistance in their work.

Gems and Precious Stones. By G. F. Kunz. The Scientific Publishing Company, New York, 1890. 4°, 336 pp., 8 colored plates, 36 figures.

The author, George Frederick Kunz, is recognized as the best authority the country affords in matters pertaining to gems and precious stones, and the present volume can but add greatly to his reputation. It certainly fills a want in bringing together a vast amount of interesting, descriptive, and historical information never before presented with any similar degree of thoroughness.

Too much cannot be said in praise of Mr. Kunz's text, which presents a world of interesting facts about precious stones and their relations to mineralogy and archæology in a way attractive not only to those whose interest in the subject is confined to its scientific side, but also to those who look to the book for entertainment. Yet it is not fiction with which Mr. Kuntz deals but an exact record, begun in 1882 for the report of the Division of Mining Statistics, and supplemented by travel and investigation.

The volume is a *chef d'œuvre* of the printer's and engraver's arts. The superb colored chromo-lithographic plates illustrating especially fine and typical specimens, by Messrs. Prang & Co., are unquestionably the finest of their kind ever published. We readily recommend this magnificent volume to all interested in the subject.

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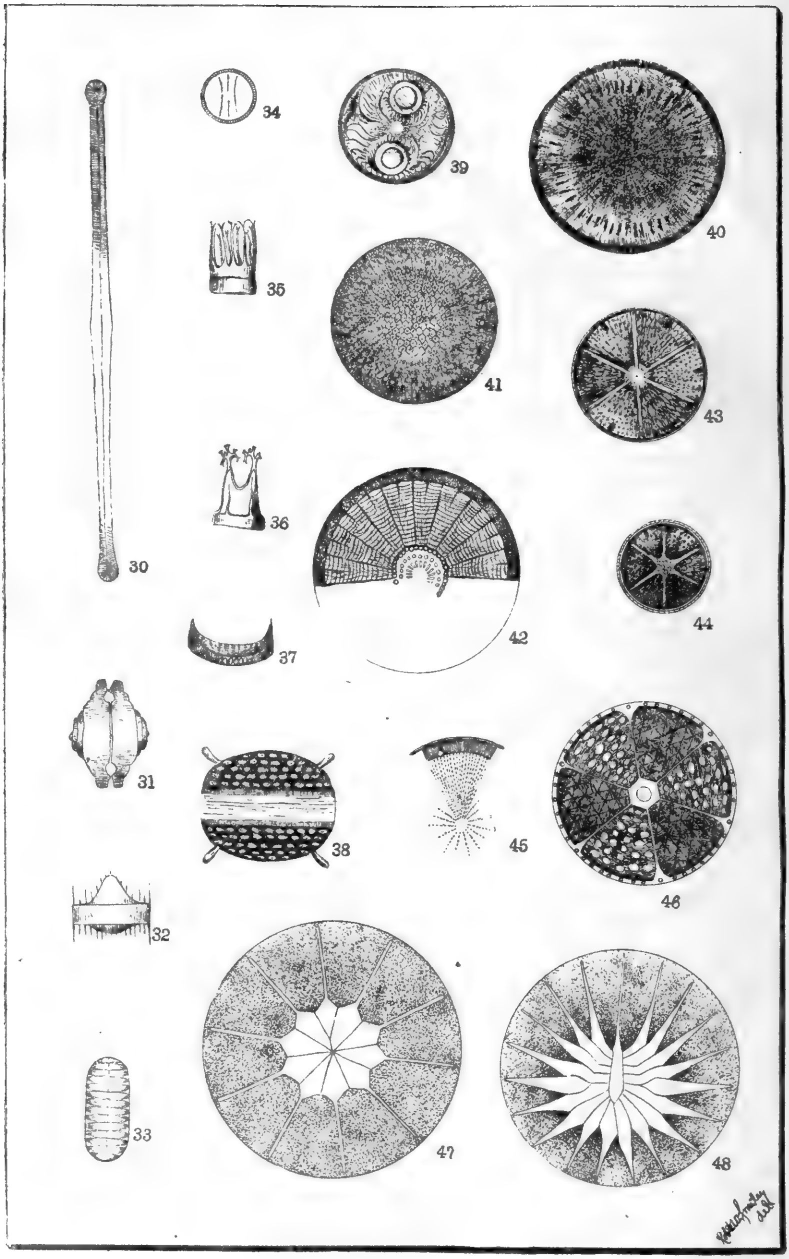

DIATOMS.—*Plate II.*

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Diatoms: Their Life History and their Classification.

BY REV. FRED'K B. CARTER,
MONTCLAIR, N. J.

[WITH FRONTISPIECE.]

(*Continued from page 101.*)

It is not claimed that the points mentioned will always be sufficient, but they will in many cases, especially when studied with the help of the figures of the fresh-water and fossil forms, and the beginner will be able to make enough progress to spur him on to identify, by closer study and the use of more elaborate keys, such forms as puzzle him ; whereas, at first, such a key, especially if it included all the genera, fresh-water, fossil, and marine, might frighten him, and possibly make him think it too much trouble to attempt the classification at all. For the drawings, I am indebted to the kindness of Mr. Robert W. Smiley, who performed a like service for me in connection with my paper on the Desmids, and I wish to express my thanks to him here. After the student has made himself familiar with the fresh-water and fossil forms, if not before, he will surely want to own a copy of Wolle's fine work on the Diatomaceæ of North America (if he can possibly do so I would advise his obtaining it at once, as the number of copies is limited), and I add here a list of references to his illustrations of the marine forms just mentioned :

LIST OF FIGURES IN THE FRONTISPIECE.

FIG. 30. Synedra fulgens.
31. Goniothecium Rogersii.
32. Hercotheca mammillaris.
33. Biblarium ellipticum.
34. Biblarium (Stylobiblium) clypens.
35. Periptera tetracladia.
36. Dicladia capreolus.
37. Hemiaulus bifrons.
38. Eupodiscus argus.
39. Auliscus Grunowii, var. Californica.
40. Systephania raeana.
FIG. 41. Coscinodiscus argus.
42. Arachnoidiscus Ehrenbergii, var. Californica.
43. Actinoptychus (Omphalopelta) areolatus.
44. Actinoptychus undulatus.
45. Actinocyclus Ehrenbergii.
46. Heliopelta nitida.
47. Asterolampra rotula.
48. Asterolampra (Asteromphalos) Hiltoniana.

Berkeleya, pl. xxxi; *Homeocladia* and *Cymbosira*, xxix; *Toxonidia*, lxix; *Amphiproralata*, ii, 20; *Eucampia*, lxvi; *Plagiogramma*, xlv; *Podosira hormoides*, lix, 16; *Pyxidicula lens*, lxii, 10; *Bacillaria*, lxviii; *Podocystis*, li; *Raphoneis amphiceros*, xxxvii, 18; *Licmophora*, *Rhipidophora*, and *Climacosphænia*, xxix; *Podosphenia*, lxix; *Striatella* and *Rhabdonema*, li; *Grammatophora serpentina*, xliv, 20; *Anaulus*, lxiv; *Biddulphia pulchella*, xcvi, 1; *Isthmia*, cix; *Chætoceros didymus*, lxv, 14; *Rhizoselenia styliformis*, lxviii, 29; *Syringidium Americana*, lxiv, 38; *Triceratium favus*, xcix, 2; *Amphitetras antediluviana*, lxiv, 39; *Syndendrium*, lxiii, 11.

So much for the genera. But when you come to the determination of species it is a different matter. You must be prepared for work of the hardest sort. The student will do well in that case to begin with either the fossil or marine genera and leave the fresh-water till the last, for it is in the fresh-water division that he will find the question of species most unmanageable. As a matter of curiosity I have taken the trouble to see how many of the genera have more than a dozen species figured in Wolle's work. There are 24 out of the 125. Omitting one that has not been mentioned in this paper, the case stands thus: *24* genera represent nearly 1,000 of the 2,300 figured, the other *100* only 300 more, or 1,300. Those 24 genera then will tax the student because each one contains a large number of species which must be distinguished. But the hard genera are not evenly distributed between the three divisions. The marine has only 4, namely, *Amphiprora*, 18; *Biddulphia*, 35; *Raphoneis*, 13, and *Triceratium*, 74; total 140: and the fossil has only 5, namely, *Actinoptychus*, 27; *Aulacodiscus*, 17; *Asteromphalos*, 13; *Auliscus*, 26; *Coscinodiscus*, 52; while the fresh water has no less than 15, and *one* of them is almost as large as all of the marine and fossil genera put together. *Amphora* has 56; *Campylodiscus*, 42; *Cocconeis*, 30; *Cymbella*, 25; *Epithemia*, 15; *Eunotia*, 33; *Fragilaria*, 20; *Gomphonema*, 23; *Melosira*, 20; *Synedra*, 30; *Surirella*, 50; *Stauroneis*, 23; *Pleurosigma*, 22; *Nitzschia*, 53; while *Navicula* has the astonishing number of *243;* total, *685*. If the beginner does not wish to go crazy therefore we advise him not to attack the genus *Navicula first*, or the fresh-water division at all until he has made the acquaintance of the marine or fossil species, which are comparatively easy.

But it is time to close this paper, which has already considerably exceeded its original limits. Just a word, then, before I end.

A remark in Rev. Wm. Smith's synopsis on the motion of the diatoms struck me as important, and as I do not remember to have seen the point stated so explicitly anywhere else, it may not be amiss to quote it. "The movements of the *Diatomaceæ*," he says (p. xxiii, vol. 1), "appear rapid and vivacious under the microscope; but it must be remembered that the high powers usually employed in the observation of these minute organisms magnify their motions as well as their bulk. I have noted the movements of several species with the aid of an eyepiece micrometer and a seconds watch, and found that one of the most rapid, viz., *Bacillaria paradoxa*, moved over 1-200ths of an inch in a second; *Pinnularia radiosa*, one of the slowest, over 1-3400ths of an inch in the same time; and that the same period was occupied by *Pinnularia oblonga* in traversing 1-2000ths of an inch, *Nitzschia linearis*

1-2500ths of an inch, and *Pleurosigma strigosum* 1-2400ths of an inch. Or expressing the spaces and times by other units, we find that the most active required somewhat more than three minutes to accomplish movements whose sum would make one inch, and the slowest nearly an hour to perform the same feat." Possibly some one may wonder how in the world under such circumstances they manage to get so quickly out of the field, and that may lead him to inquire how large a field they really cross.

In conclusion, let me again strongly urge the student to make constant use of the Binocular in the examination of these forms.

[THE END.]

The Annual Soirée of the Washington Microscopical Society.

By ROBERT W. SMILEY,

WASHINGTON, D. C.

The seventh annual soirée of the Washington Microscopical Society was held in the halls of the High School building on the evening of April 21, 1891. After listening with pleasure to the illustrated address by the president, Dr. Thomas Taylor, the large audience dispersed through the corridors to view the interesting objects displayed. The following exhibits were made:

By Dr. G. N. Acker, with Zeiss and Hartnack: Section of human lung, and Nailer's lung.

By Dr. W. W. Alleger, with B. & L.: Trichinæ.

By Dr. E. A. Balloch, with Zentmayer: Stomach of turtle.

By Dr. I. W. Blackburn, with Zentmayer: Tumor of brain, pathological specimens, and knife carrier.

By Prof. E. S. Burgess, with B. & L.: Various tissues of plants, showing their structure.

By Dr. C. T. Caldwell, with B. & L.: Photo-micrographs.

By Dr. A. B. Coolidge, with B. & L.: Transverse section of ostrich egg-shell.

By Dr. Cooper Curtice, with B. & L.: Trichinæ.

By Dr. H. A. Dobson, with B. & L., special: Brazilian beetle.

By Mr. W. C. Duff, with B. & L., universal: Section of finger.

By Mr. H. H. Doublebay, with Crouch: Circulation of blood in fish.

By Dr. J. M. Flint, with B. & L., College: Foraminifera.

By Mr. Richard Foster, with B. & L. (polariscope): Quartz crystals between mica, and infusoria.

By Dr. E. A. Gibbs, with Beck's Ideal, and B. & L.: Polycystina, and pond life.

By Mr. John Grinsted, with B. & L.: Amœba.

By Dr. H. L. E. Johnson, (exhibit not catalogued).

By Dr. D. S. Lamb, with B. & L., Model: Skin of frog (injected), and ciliated epithelium of oyster.

By Dr. J. Melvin Lamb, with B. & L.: Tubercle bacilli, phthisis, ($\frac{1}{6}$ objective), and the same after treatment with Koch's lymph.

By Dr. Collins Marshall, with Queen's Acme, No. 3: Crystallized gold.

By. Dr. V. A. Moore, with Zeiss, No. 1: Typhoid fever bacilli, showing flagella.

By Mr. Lewis Mooers, with Seibert, (polariscope): Ethyl gallate.

By Dr. S J. Radcliffe, with Beck: Seed vessel of poppy.

By Dr. Robert Reyburn, with Beck and Queen: Eggs of water snail, *Lymnia stagnalis*, and boquet of flowers.

By Dr. H. A. Robbins, with Reichert: Tongue of rabbit.

By Dr. C. W. Richardson, with Zentmayer's Histological: Transection of bone showing Haversian canals.

By Dr. Wm. H. Seaman, with B. & L.: Pond life.

By Mr. A. N. Skinner, with Zentmayer's Histological: Circulation of blood in frog's foot.

By Mr. C. W. Smiley, with Crouch's Histological, (polariscope): Potassium chlorate.

By Dr. C. H. Stowell, with Beck's Ideal: Section of human scalp.

By Dr. J. F. Scott, (exhibit not catalogued).

By J. M. Stedman, B. S., with B. & L's. Investigator, and Harvard, (polariscope): Section of granite, and embryo of chick, thirty-six hours incubation.

By Dr. Thomas Taylor, with large Zeiss, and Bulloch: Pure and compound lard.

By Mr. J. M. Yznaga, with B. & L.: Honey bee (various parts).

This exhibit of objects was a credit to the Society, and served its purpose in that it afforded the visitors a very interesting and instructive evening's enjoyment, tending, as it did, to interest the public to a just appreciation of the science of miscroscopy.

Simple Method of examining living Infusoria.—Herr J. Eismond has discovered a method of showing those rapid movements of infusoria which make the examination of these objects during life so difficult. The method is based on that of crystallographers, who retard the formation of crystals by the addition of a colloidal material. He added a drop of thick watery solution of cherry-gum, and obtained the desired effect. In a very short time the ciliata were seen to be imprisoned, with all their cilia moving actively, but effecting no change in position. All the vital processes can be most satisfactorily observed in infusoria so treated, and a certain amount of locomotion can be allowed by using a less dense solution. Small crustacea, worms, and flagellata, and other marine animals, may be well studied by this method. It may be added that gum-arabic and other fixing materials are useless. —*Zoologischer Anzeiger*.

———o———

To Preserve the Edges of Microtome Knives.—To render instruments perfectly aseptic, and to preserve the cutting edges from oxidation, they should be boiled for five minutes in a one per cent. solution of carbonate of sodium. They can remain in this solution indefinitely without rusting or dulling the cutting edge. When required for operation they are taken out, dried with a sterilized piece of gauze, and handed to the operator. Whenever, in course of operation, they come in contact with anything not asceptic, all that is required to re-sterilize them is to dip them for a few seconds into the boiling solution of sodium bicarbonate.—*Dental Review*.

Introduction to Elementary Biology.

By HENRY L. OSBORN,

HAMLINE, MINN.

Part 1.—Protoplasm.

1. Protoplasm is the most marvelous substance in the world. The ancients loved to believe in fairies and genii and other mythical personages, whose beneficent or harmful actions affected man's welfare, and whose performances came under his control who knew the word of command by which they were directed. But the ancients did not go so far as to suppose that these things were so intimately related to man as to really compose his bodily essence. At this point reality transcends the strongest flights of the imagination and fact is verily stranger than fiction. For there is a substance—protoplasm—which pervades all living bodies, however varied their form, however remote their separation in space, which is at bottom alike in all, and which is the active, working, physical agent whose performances we call flight in bird, speech in man, storing starch in the potato, sensibility in the sensitive plant. secretion in the liver, and so on through the catalogue of actions of living things. So far as we know with any positive certainty mind does not act except over the medium of protoplasm to produce effects upon the material universe, and this has led some speculative minds to the very illogical conclusion that mind and protoplasm are identical. Such an inference is no more necessary than the conclusion of a savage, who, hearing a clock strike regularly at every hour, regards such accessory noise as a necessary attribute of a horologue.

2. **Structurally considered**, protoplasm is a very fine-grained substance suspended in slightly saline water. Its consistency is neither fluid nor solid, but gelatinous. A great deal of study has been given to the ultimate structure of protoplasm, but an exact and indisputable statement upon the point cannot yet be made. It is generally supposed that the watery and the solid portions of protoplasm have distinct places in the mass, the latter forming some sort of fibrillar network comparable perhaps with a sponge, the interstices of which are occupied with the watery portion. The difficulty of understanding the ultimate structure of protoplasm is akin to that in the case of any mass, say iron, or even water, and is due to the fact that we have to do with intangible molecules, and yet a clear and true knowledge of this subject would help vastly in the study of the activities of protoplasm in relation to energy.

3. **Chemically considered**, protoplasm is also full of perplexities and its study of difficulties. The chemist can very easily discover carbon, oxygen, hydrogen, nitrogen, sulphur, and phosphorous in protoplasm, and that there are three classes of compounds. These compounds are the proteids, the carbohydrats and the fats. But when he has reached this point his trouble begins, for he now finds that protoplasm parts with its life the instant he touches it and instant dissolution follows the fatal contact, so that living protoplasm defies direct chemical analysis. And, moreover, the various permutations and combinations of the atoms of carbon, and so on, are so innumerable that organic chemistry has become discouragingly bulky. However, the researches into the chemistry of protoplasm are on solid ground, and we can say with very great confidence that the solid portions of protoplasm are composed of all three kinds

of carbon compounds, proteid which is nitrogenous, carbohydrate, or starchy matter and fat. The particular kind of proteid, starch, or fat is not constant, but varies with the location of the protoplasm. It will be well for us to note here and keep in mind the fact that these organic compounds constituting protoplasm are of high potential energy. They have been made the reservoirs of forces (derived in the first instance from the sun). They are hence unstable, and under suitable conditions, viz., heat and the presence of free oxygen, they will "break down" into simple mineral compounds of the same elements as compose them, at the same time setting free for work the force which had been latent before the oxidation.

4. **Powers of Protoplasm.**—The marvel about protoplasm is that it can do such wonderful things. It can weave, and spin, and brew. All that living things can do are done through it so far as we have learned. The various powers of protoplasm are best considered separately and they may be considered under three heads: First, the power of regulating chemical changes, called in scientific diction *metabolism;* second, the power of changing the position of its components, and hence its shape, called the power of *movement;* and third, the power of responding to any impression from without, together with the power to retain the effect of the impression or transmit it, possibly all phases of the same power, called *irritability*. Each of these we shall now consider.

5. **Metabolism.**—Living protoplasm can regulate chemical action. It can check it and thus prevent oxidation of its unstable compounds, a tendency at once followed by dead protoplasm unless prevented by some preservative precaution, or it can allow oxidation to go on in certain degrees. It can inaugurate chemical reactions by presiding, one might say, over the march of atoms to and from ranges of attraction which would result in the production of certain compounds. One of the most easily noticed cases of this power of protoplasm is exhibited by the germinating seed, as for instance that of the bean. This seed, if placed on a moist sponge and kept warm, will soon soften, swell, and split open. A young sprout plainly seen within will elongate and soon become a pair of genuine leaves, with ribs and leafy shape and texture, but white. Later, however, the leaves become green. This green matter, *chlorophyll*, is a peculiar chemical of well-known composition. Its color ought to help us to find it in the ungerminated seed if it has been stored away there, bnt we cannot find it there. It must, then, have been made by the protoplasm of the bean. Now, though chlorophyll does not exist in the plant, other compounds do exist there which can be made over into chlorophyll by taking out an atom here and there and re-arranging the compound, and this the protoplasm can do. This is metabolism. There are two sorts of metabolism; one in which the protoplasm alters compounds from more complex to less complex ones. This kind predominates in animal protoplasm and is called destructive metabolism or katabolism. Another, in which the protoplasm builds more and more complex compounds out of simple ones, is called constructive metabolism or anabolism, and is characteristic in a broad sense of vegetal protoplasm.

6. **Movement.**—It is obvious upon reflection that the power of metabolism, or we may say self-control over chemical reaction, is not of

itself a sufficient endowment to enable protoplasm to be "the physical basis of life" which it has very properly been called. For, armed with this power alone, it could only at best be little better than at the mercy of hazard as regard its supplies of substance, and one of the most noticeable facts of living things, their wonderful increase and spread, would not be easily interpreted. Protoplasm has, then, a second power—that of altering the relative position of the molecules of its substance, whereby a change of its shape as a mass is brought to pass. By this power masses of protoplasm can change position and come into new relations—a most important endowment for all living things, since it not only may bring them into new and unexhausted supplies of substance necessary for the exercise of metabolism, but may also give them numerous possibilities of direct interaction upon each other which may be of great importance. The masses can also change their shape and change the position of connected parts. By virtue of this power muscle can pull on tendon and this on bone, and through motion in protoplasm joints be bent. As before remarked, this power is brought into great prominence in the animal body while the metabolic power is inconspicuous though universally present, energy being furnished for movement by katabolism, and this form of metabolism being the chief one exercised by animal protoplasm.

7. **Irritability.**—The third power of protoplasm, its irritability, may be conceived of as an oscillation among the molecules of the structure caused by a disturbance from outside the protoplasm, which oscillation is transmitted to all parts of the protoplasm and in a wholly mysterious way leaves a trace of its effect, whereby every subsequent similar disturbance more easily causes a repetition of the oscillation. This last power of protoplasm is at the foundation of the nervous system in animals. It is present in the plants, but in the higher ones is not obvious, though doubtless exercised. The irritation of protoplasm, or in scientific language stimulation, may imitate the action of any of its other functions, as motion or metabolism, and, in a complex body, this power makes the co-working of parts possible. Some of the most materialistic of philosophers think that when these powers of protoplasm are fully understood they will be found to explain all the phenomena of life, but we must most carefully notice that in all of this analysis we do not in the least open or decide the underlying philosophical question of the source and guiding control of these forces and the myriads of results of their varied combinations. Science goes no farther than to recognize these primary facts : first, that protoplasm is a definite material substance, a mixture of saline water and very complex and unstable chemical compounds ; second, that living protoplasm can perform acts which we class as metabolism, motion, and sensation. The explanation of these data is metaphysical and the province of philosophy.

Our next task will be to examine some of the forms under which protoplasm exists in living bodies, and the way in which these powers are exercised in the cells and tissues.

[*To be continued.*]

Pure Culture of Gonococcus.—Von Schrötter and Winkler recommend the albumen of plover's eggs as an excellent nutritive medium for easily obtaining pure cultivations of Neisser's gonococcus.

Some Trifles Worth Knowing.

By E. H. GRIFFITH,

FAIRPORT, N. Y.

Lateral Motion.—Many who are versed in optics forget certain well-known laws of light when they are using the microscope, and the result is sometimes expensive. Only a few days ago, while visiting a microscopist, he told me of an exchange of stands that had been made by a physician of the city with the representative of a microscope manufactory. The agent by pushing the mirror one side convinced the doctor that his instrument tube had lateral motion, then by setting the mirror of his own instrument central its superiority was easily demonstrated to the amateur, and he paid a good sum in exchange. If those who own microscopes will devote a few hours to the different results obtained by changing the position of the mirror they will be well paid for their time and trouble. Oblique illumination will give the appearance of lateral motion in the tube of the best microscope ever made.

High Powers in Oculars.—Not long ago, while experimenting with my microscope, I removed the field lens of the eye-piece and laid it on top of the eye-lens. To me the result was a surprise. Let those who desire extra power in oculars try the experiment.

A Cheap Condenser.—One day, when in St. Paul, Minn., a friend showed me some glass globes which were filled with liquid and which were being sold for microscopes of wonderful power. My friend being an enthusiastic microscopist, condemned the toys. I suggested that he fit the end of the stem of the globe to a bit of wood which could slide in the groove of the mirror-bar and above the mirror and that he use it as a condenser. A few hours later I called to see him, and I found him at work with his 25-cent condenser, which gave very satisfactory results.

Microscopical Laboratory Notes.*

By H. M. WHELPLEY, Ph. G., F. R. M. S.,

ST. LOUIS, MO.

Dissecting Knives.—The delicate blades of small dissecting knives are liable to become injured if the instruments are not carefully cared for when not in use. I find that a small piece of thick blotting-paper can be slipped over the blade like a sheath to a sword. If the blade is dipped in vaseline before putting it away there is no danger from rust.

A Clean Cloth.—It is customary to have an old silk handkerchief convenient for the purpose of wiping off objectives, cover-glasses, slides, etc. It is also quite common to see this cloth left out in the dust and dirt. I keep the piece of old silk in a tight box, so that it is not gathering dust when not in use. When it becomes soiled it should be washed.

Labeling Slides.—Not every one stops to think how much more convenient it is to have the principal label on the left hand end of a slide. We naturally pick up a slide with our right hand and grasp it by the right hand end. This covers up the label on that end, so I make it a practice to place the label on the left hand end; or, if two labels are to be used, I put the main one on this end and the less important one on the right.

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The Ammoniacal Fermentation of Urine.*

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The fact is well known that urine undergoes putrefactive changes when it is allowed to stand for a considerable length of time at the ordinary temperature. In following these in the order of their occurrence we find that the clear urine first becomes faintly, then heavily clouded, and finally, after several weeks standing, it clears with the formation of a considerable quantity of a grayish, more or less granular sediment. The color of the cleared urine is always several shades darker than that of the fresh liquid. A further examination shows that its acid reaction is converted into an alkaline one simultaneously with the occurrence of the clouded appearance. With this change in its chemical reaction the odor becomes penetrating and ammoniacal in character. The source of the ammonia was explained by the discovery of urea, and later investigations made by Prout showed that the urea was converted into carbonate of ammonia by a process of hydration. By "ammoniacal fermentation of urine," therefore, is meant that change in urine by which its urea is transformed into carbonate of ammonia.

The careful chemical investigations that have been made during the past two centuries for the purpose of determining the cause of this transformation of urea into carbonate of ammonia have been negative in their results. Van Helmont, in the seventeenth century (1682), believed the cause to be the action of some putrefactive ferment, the exact nature of which he did not know. He was supported in this theory by other investigators following him. A satisfactory explanation of this phenomena was not made, however, until the time of Pasteur, who showed that the "ammoniacal fermentation" was due to the presence of an organized ferment (micro-organisms). This discovery transferred the line of investigation of this subject from a purely chemical to a biological basis.

The bacteriological investigations of this subject by Pasteur, Van Tieghem, Miquel. Leube, and others during the last thirty years have been so confirmatory that no further evidence is necessary to establish the theory of an organized ferment advanced by Pasteur. I have repeatedly preserved urine for several months in apparently a perfectly fresh condition by first sterilizing it by discontinuous heating for several days at a temperature of 65° C., after which it was continuously exposed to a temperature most favorable for the development of ammoniacal fermentation; also by placing it unsterilized in a temperature below that necessary for the development of bacteria. The results of many carefully-conducted experiments warrant the statement that without the development of certain bacteria urine will remain unchanged although subjected to all the other influences necessary for this decomposition. As experiments have shown that the urine within the healthy bladder of people not suffering from bacterial disease is germ free, it is evident that the organisms producing this decomposition are to be sought for among the external surroundings or in the urethral canal, where they have either entered by accident or where, when once introduced,

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they remain in accordance with some as yet unknown law of localization. Their presence in this canal is shown from the fact that urine passed directly into sterile flasks without external contamination will undergo decomposition ; but if the urethral canal is previously disinfected it will remain unchanged for an indefinite time.

Biological History.—In 1860 Pasteur (1) showed that in decomposing urine the transformation of the urea into carbonate of ammonia was due to a micrococcus which he found and designated as *Torula ammoniacale*. A few years later Van Tieghem (2), in his inaugural thesis, presented to the "Faculty of Sciences of Paris," considered the cause of ammoniacal fomentation to be due to the action of micrococcus (*spherical globules*), which arranged themselves in long chains (streptococci).

Twelve years later (1876) Pasteur (3) recognized streptococci in decomposed urine, but says: "They must not be confounded with the ferment of urine, which they resemble in the diameter of their grains. The ferment of urine is formed of *couples de grains*" (diplococci). Whether or not the streptococcus of Van Tieghem and the diplococcus of Pasteur are identical we will not attempt to decide. The crude condition of bacteriology at that time will admit of their being considered identical species, notwithstanding the discrepancies in the original descriptions. Professor Leube and P. Miquel have considered them as belonging to the same species.

In 1879 P. Miquel (4) isolated a rod-shaped germ from decomposed urine, which, when introduced into sterile urine, would cause it to undergo ammoniacal fermentation. He gave it the name of *Bacillus urea*.

Six years later (1885) Professor W. Leube (5) published an article upon "The Ammoniacal Fermentation of Urine." in which he describes three rod-shaped germs and one micrococcus isolated from urine and a sarcina from the saliva that would transform urea into carbonate of ammonia. The rod-shaped germ first described he called *Bacterium urea*. The other two are not specifically named other than by number. The micrococcus he considers to be the same as the one studied and described by Pasteur and Van Tieghem.

Flügge (6) describes a micrococcus that was isolated in his laboratory and which produced the same effect on urine as the micrococcus described by Pasteur. On account of its power to liquefy gelatine it was called *Micrococcus urea liquefacinas*.

In 1889 P. Mique (7), in an article on "Ferments of Urine," describes six bacilli (Bacillus urea φ, B. u. β, B. u. γ, B. ε, B. δ, and B. ρ), five micrococci (Micrococcus urea φ, M. u. β, M. u. γ, M. u. δ, and M. u. ε), and one sarcina (Sarcini φ), which would transform urea into carbonate of ammonia. The *Bacillus urea* β is the same as that described by him in 1879, and he considers it the same as the *Bacterium urea* of Leube. He quotes from several investigators who have conceded to him the priority in the discovery of this bacillus. The micrococcus urea φ is the same as the micrococcus urea of Leube, and is supposed to be the same as the micrococcus studied by Pasteur and Van Tieghem. The sarcina is the same as that described by Leube. To summarize, we have as organized ferments of urine already described six micrococci (Pasteur's, Flügg's, and Miquel's), seven bacilli (eight of Miquel's *Bacillus urea*

β and Leube's *Bacterium urea* are not identical), and one sarcina that are more or less active in the transformation of fresh into ammoniacal urine.

In considering the source of the organisms, we find that Pasteur, Van Tieghem, and Leube isolated their germs from decomposed urine. Flügge does not give the material from which he obtained his micrococcus urea liquefacians. Miquel found the germs he described in the atmosphere, soil, and water. Pasteur also found his *Torula ammoniacale* among the germs isolated from the atmosphere.

In view of these facts, I have confined my investigations thus far principally to those forms of bacteria that are to be found within the healthy urethral canal. The object of such a limit was to determine, if possible, whether or not there are certain bacteria that are constantly present in this canal which act as exciting agents in the transformation of fresh into ammoniacal urine. If this question can be definitely settled it may be effectual in explaining the causation of certain cases of cystitis which are rapidly developed after the introduction of bougies and catheters. Dr. Ricard (8) finds that if these instruments are made aseptic their introduction is harmless, providing the urethral canal is not infected; but if the urethral canal is already infected, it must previously be washed with a saturated solution of boric acid in order to avoid a subsequent more or less acute cystitis. It seems reasonable to suppose that if bacteria that are capable of transforming urea into carbonate of ammonia are found constantly within the healthy urethra that this canal as well as the instruments should always be thoroughly disinfected before any operation is attempted.

Methods Employed in Collecting and Examining Urine.—The methods employed both in collecting the fresh urine and in its subsequent examination are of much importance and worthy of careful consideration. The following precautions were rigorously adhered to in collecting the fresh liquid: The glans and external urinary meatus were carefully disinfected with either a 5 per cent. solution of carbolic acid or a 1-1000 solution of corrosive sublimate. The urine was passed directly into a sterilized Erlenmeyer flask, the mouth of which was previously flamed and the cotton-wool stopper replaced immediately after urination. Care was also taken to avoid dust and currents of air. A few cubic centimeters were immediately removed from the flask by means of a sterile pipette for a preliminary chemical examination. Only normal acid urine was retained for the bacteriorological examination.

For the isolation of the germs the well-known Koch gelatine-plate method was employed. Esmarch rolls were at first tried, but on account of the presence of liquefying germs they were abandoned. In several cases a plate culture was made from the fresh urine by adding from ¼ to 1 c. c. of it to a tube of liquid gelatine by means of a sterilized pipette, and after thoroughly mixing, pouring the gelatine upon sterile glass plates. These were kept at a temperature of 65° to 75° F. These plates developed from one to four colonies, occasionally more, often none at all, showing how comparatively few bacteria there are in freshly voided urine. The flasks were allowed to stand at the ordinary temperature (65° to 75° F.) for from 24 to 48 hours, when the urine became clouded and either neutral or alkaline in reaction. A microscopical examination at this time showed a greater or less number of bacteria

present. Plate cultures in gelatine were then made. One small platinum wire loop (holding from $\frac{1}{60}$ to $\frac{1}{50}$ c. c.) of the fermenting urine was added to a tube containing about 10 c. c. of liquid gelatine. After thoroughly mixing, from 2 to 4 loops of the first gelatine were added to a second tube of gelatine. The gelatine was poured on sterile plates. (These were carefully protected from external contamination by means of flamed bell-jars. Sterile "double-dishes" were also used.) They were kept at a temperature varying from 65° to 75° F. The number of loops taken for the first tube of gelatine depended upon the number of germs seen in the microscopical examination. When the germs were exceedingly numerous the first dilution was made in a tube containing about 7 c. c. of sterile distilled water. The first plate usually developed innumerable colonies after 24 to 48 hours. The second plate as a rule developed from 50 to 300 colonies. As soon as they were sufficiently developed they were examined both *macroscopically* and *microscopically* and a subculture made in sterilized urine and gelatine from a colony of each apparently different form. The plate cultures were repeated after the urine had reached its maximum degree of alkalinity, and again after it had been standing for from 2 to 3 weeks. In a few cases parallel plates in agar were made, but no germ was found to develop in this medium that did not grow on the gelatine. The subcultures were carefully examined, and all those in which the urine culture became alkaline were retained for more careful study. By this process I have isolated from urine about 12 forms of bacteria, mostly micrococci, of which five, on account of their property of producing ammoniacal fermentation in urine, will receive a somewhat detailed description. Of the remaining forms, one was a streptococcus which was present in every specimen of urine examined, two were bacilli, and the remainder were micrococci. The bacilli were very rarely found.

Culture Media Employed in Testing the Reaction of These Germs.—For a preliminary examination of these germs the ordinary culture media were employed, but in order to test their power to transform urea into carbonate of ammonia, media containing that substance were necessarily resorted to. Of those sterilized, normal urine seemed to be the most practical. Other media, such as acid-beef-infusion-peptone and gelatine plus urea, were also employed. Of the ordinary media, nutritive gelatine was the most important from a differential standpoint.

(1) *Steril urine.*—This was prepared by distributing fresh acid urine in sterile culture tubes, about 10 c. c. in each tube. As the urea is broken up by a high temperature the tubes were placed in a large water-bath and heated to a temperature of 65° C. for two hours each day for four consecutive days. Their sterility was tested by allowing them to stand for several days in an incubator at a temperature of 36°. C. The urine remained in every instance clear and acid in reaction.

(2) *Acid-bouillon plus urea.*—This was prepared by macerating 100 grams of finely chopped beef (freed from fat) in 200 c. c. of distilled water. After standing for from 18 to 24 hours in a cool place it was strained through a coarse linen, and to the simple beef-infusion ½ per cent. sodium chloride and 1 per cent. peptone were added. It was then boiled for thirty minutes, cooled, filtered, and ½ per cent. urea added. The liquid was then distributed in sterile culture tubes, and sterilized

by heating at 65° C. for three hours each day for four consecutive days. It remained clear and acid after standing for several days at a temperature of 36° C

(3) *Acid gelatine plus urea.*—This is prepared in precisely the same manner as the acid bouillon, with the addition of 10 per cent. gelatine, which is added before the beef-infusion is boiled. The urea is added to the liquid gelatine after it is filtered. It is preserved in sterile cotton-plugged test tubes and sterilized by the same method as the bouillon. after which it remained clear and acid in reaction.

Description of New Germs.—In the light that we already have concerning this class of organisms, and in the present unsettled condition of bacteriological classification, it seems more desirable to omit the assigning of specific names to the micrococci about to be described, but simply differentiate them with reference to their morphological characters and their growth in certain culture media. They will, therefore, be designated by the first letters of the alphabet, as *micrococcus A*, *micrococcus B*, etc. In comparing the morphological and cultural characters of these bacteria with the description of the micrococci described by Pasteur, Flügge, and Miquel I have failed to find sufficient resemblances to establish their identity. Their effect upon urea in nutrient solutions is, however, practically the same.

Micrococcus A.—A micrococcus varying in diameter from 0.6 μ to 1.2 μ; average 0.9 μ. When grown in bouillon the cocci most usually appear in small clumps and in the form of diplococci. There seems to be a marked disposition in the cocci to be closely united in pairs. In acid bouillon they are frequently observed united in short chains.

Agar (surface growth) at 36° C.—After 24 hours round, convex, grayish colonies appear with a glistening surface and sharply defined border. When they are separated by a distance of one-half inch or more they are about 1 millimeter in diameter. After growing for several days the colonies become opaque and whitish, but are otherwise unchanged in appearance. The colonies are quite brittle. The growth in the condensation water is quite vigorous, giving it a clouded appearance.

Gelatine (needle culture).—In nutrient gelatine the growth is quite vigorous at 70° F. Along the needle track, after 24 hours, a grayish, opaque, somewhat granular line appears, which consists of crowded colonies. At the surface the growth is more vigorous, forming an elevated glistening band around the needle puncture. This may be due to the greater number of germs collected there. On the second or third day the gelatine begins to liquefy along the entire length of the needle track. At first the liquefaction is generally more rapid on the surface, giving a cone-like appearance to the liquid portion, the base being at the surface. Very often the liquefaction is in the form of a cylinder. The entire mass of gelatine is liquefied in from 8 to 20 days. In a higher temperature (75° to 80° F.) the growth is more rapid. The liquid gelatine holds in suspension fine granular masses of germs $\frac{1}{10}$ to $\frac{1}{4}$ millimeter in diameter. A considerable quantity of a grayish sediment collects in the bottom of the tube; a fine granular pellicle also forms over the surface. Both the pellicle and sediment are very viscid. The liquefied gelatine will not set, showing that it has become peptonized.

In alkaline bouillon the growth is very feeble, the liquid becoming barely clouded, even after several days standing. In acid bouillon the growth is at first also feeble, but on the second day it is very much increased, the liquid becoming quite clouded, and a granular pellicle forms over the surface. The acid reaction is not appreciably changed. In sterile milk at 36° C. this germ coagulates the casein after about two weeks standing. It grows very vigorously. The reaction remains slightly acid. A slight sour-milk odor is emitted.

Sterile urine at 36° C. This germ multiplies very rapidly in this liquid. After 18 hours it becomes quite clouded with the formation of a grayish sediment. Its acid reaction is changed to a feebly alkaline one, which becomes very strong after 36 to 48 hours. The odor is penetrating, resembling that emitted by ammonia water. In acid bouillon plus urea at 36° C. this germ grows very rapidly. After 24 hours the liquid is very clouded, with considerable sediment formed in the bottom of the tube. The reaction is changed to a strong alkaline one. A slight ammoniacal odor is emitted. In the acid gelatine plus urea the growth is more vigorous and the liquefaction more rapid than in the ordinary gelatine. With the liquefaction its reaction is changed to a strong alkaline one. The liquid gelatine becomes perfectly cleared, with a somewhat viscid sediment.

This germ is easily stained with the aniline dyes. It does not take the Gram stain.

Micrococcus B.—A micrococcus varying from 1.0 μ to 1.8 μ in diameter; average, 1.4 μ. It occurs single, in pairs, and in small clumps. It is occasionally seen in short chains, especially when grown on agar or gelatine.

Agar (surface growth) at 36° C.—The growth of this germ on agar resembles in its general appearance that of the micrococcus A. It differs from that germ in two respects: (1) The growth on the surface is very viscid. (2) The condensation water remains clear, with a grayish, somewhat viscid growth at the bottom.

Gelatine (needle culture) at 75° F.—After 24 hours a grayish granular line appears along the needle track. At the surface the growth is more vigorous, spreading and liquefying the gelatine in a thin layer over the entire surface. The growth along the needle track does not increase, but the gelatine gradually liquefies from the surface downward until from one-half to two-thirds of the gelatine has become liquid. The liquefaction does not extend beyond that point. A more or less thick, whitish membrane forms over the central portion of the surface, rarely forming a complete pellicle. A layer of grayish, viscid growth forms over the surface of the non-liquefied gelatine. The liquid portion holds in suspension grayish granules, which are occasionally so fine as to give a uniform clouded appearance to the liquid gelatine. The liquefaction is completed in from one to two weeks.

In bouillon at 36° C. the growth is very feeble. After 24 hours the liquid is very faintly clouded. In from two to four days a somewhat stringy growth appears in the upper part of the liquid; also granular masses, varying from 1 to 2 millimeters in diameter. These are quite viscid. In acid bouillon, after several days a few granular masses are formed on the surface; also a whitish deposit on the sides of the tube at the surface of the liquid.

In sterile milk this germ, after about two weeks, coagulates the casein, leaving a clear supernatant liquid.

Sterile urine at 36° C.—This germ grows rather feebly in urine. After 24 hours the liquid is very faintly clouded and neutral in reaction. After 48 hours it is strongly alkaline and clouded with the formation of a small quantity of sediment. In acid bouillon plus urea the growth is not vigorous. After 24 hours the reaction is feebly alkaline. At the end of two to three days the reaction is strongly alkaline and the liquid quite cloudy with a slight penetrating odor. In acid gelatine containing urea the growth is more vigorous than in the ordinary gelatine. The liquefied gelatine is strongly alkaline in reaction.

This germ is easily stained with the aniline dyes. It takes the Gram stain.

Micrococcus C.—A micrococcus varying in diameter from 0.8 μ to 1.5 μ; average, 1.2 μ. It occurs single, in short chains, and in small clumps. There are also diplococci forms.

Agar (surface growth) at 36° C.—On this medium the growth does not differ appreciably from that of micrococcus A.

Gelatine.—This germ liquefies gelatine very slightly, so that the growth, which at first is upon the surface, after several days becomes slightly depressed, never more than one to two millimeters. The growth along the needle puncture is whitish, opaque, viscid, and quite thick. The colonies along the needle track are very small. They do not liquefy the gelatine.

In bouillon the growth is very feeble; after 24 hours the liquid becomes faintly and uniformly clouded. There is no further development. Sterile milk inoculated with this germ and kept at a temperature of 36° C. becomes thickened in the lower half of the tube after about six days. There is no separation of the casein from the aqueous portion; no odor; slight acid reaction.

Sterile urine.—In this liquid the growth is feeble. On the day following its inoculation the reaction is faintly alkaline, the liquid barely clouded. On the third day there is a thin granular deposit on the sides of the tube, and the reaction is strongly alkaline. In acid bouillon plus urea at 36° C., the liquid becomes clouded on the day following the inoculation, with the formation of a considerable quantity of sediment; strong alkaline reaction, penetrating odor. After ten days standing it becomes clear, with a sediment. It remains strongly alkaline. In acid gelatine plus urea the growth is very feeble; no liquefaction.

It is easily stained by the ordinary methods. When stained according to Gram a great majority of the cocci take the brown stain perfectly. A few (about one in fifteen) retain the blue stain. These are of the maximum size (1.5 μ).

Micrococcus D.—A micrococcus varying in diameter from 0.7 μ to 1.2 μ; average, 0.9 μ. It grows most usually in small clumps and in pairs. It is very rarely seen single.

Agar (surface growth) at 36° C.—When not crowded the isolated colonies, after 24 hours, are from 1 to 1½ millimeters in diameter, round, flat, with a smooth border and sharply defined margin; a considerable growth in the condensation water. The colonies at first are grayish white, glistening, but after several days they become a light cadmium yellow. The size is very slightly increased. When grown on agar

containing 5 per cent. glycerine the growth is more feeble, but the color more intense.

Gelatine (needle cultures).—Along the needle track the colonies develop after 24 hours as minute grayish points. After several days they attain to a diameter of $\frac{1}{8}$ to $\frac{1}{4}$ millimeter, spherical, granular, yellowish. On the surface the growth is spreading, glistening, of a deep cadmium yellow. The growth about the needle puncture appears in more or less concentric bands. The outer bands also have a radiating appearance, produced by alternate lighter and darker lines extending outward from the more central portion. After about two weeks the growth becomes slightly depressed below the surface.

In bouillon the growth is feeble. After 48 hours, at 36° C. the liquid becomes clouded in the upper portion with a small quantity of a grayish deposit formed on the side of the tube. It produces no change in the appearance of milk.

Sterile urine.—In this liquid the growth is abundant; the liquid is heavily clouded after 24 hours; the reactions strongly alkaline. After from two to three days a considerable quantity of sediment is formed in the bottom of the tube. This germ is the most rapid in its transformation of acid into alkaline urine of any of the germs here described. Under its influence acid urine will become decidedly alkaline in eighteen hours. In acid bouillon containing urea the growth is vigorous. In 24 hours the liquid is very cloudy and strongly alkaline in reaction. In acid gelatine plus urea the growth is more feeble than on the ordinary gelatine. It takes the Gram stain.

Micrococcus E.—A micrococcus varying from 0.9 μ to 1.5 μ in diameter; average, 1.2 μ. It most usually occurs in small clumps and in pairs. It is frequently found single, often in short chains.

Agar (surface growth) at 36° C.—After 24 hours quite fleshy, round, convex colonies appear, 1 millimeter in diameter when not crowded. They are of a grayish yellow color, opaque. After several days the growth becomes a much deeper yellow. The condensation water is clear, with a viscid, flaky growth at the bottom. The surface growth is not viscid.

Gelatine.—The growth in this medium resembles that of the micrococcus B. It differs from it in the color of the membrane and sediment, which are cadmium yellow.

In bouillon the growth is feeble. It does not produce any apparent change in the appearance of milk.

Sterile urine.—The growth in this liquid is very slow. On the second day after inoculation it becomes feebly alkaline, with the formation of a granular deposit on the sides of the tube. In acid bouillon containing urea the growth is more vigorous. After one day at 36° C. the reaction becomes strongly alkaline, emitting a penetrating odor. It liquefies acid gelatine containing urea very slowly. The liquefaction does not extend more than three to five millimeters below the surface. The liquid gelatine is strongly alkaline in reaction. This germ is readily stained by the ordinary methods. It takes the Gram stain.

The characteristic properties of these micrococci, especially their reaction on nutrient gelatine, are more or less modified by cultivation. Their power to break up urea, however, does not seem to be diminished.

I have examined, after the methods previously described, twelve specimens of urine. Of these seven contained only the micrococcus A, two the micrococcus C, one the micrococci A and B, one the micrococci B and D, and one the micrococci A, C, and E. Eight of the specimens were taken from the same individual, six of which contained (of the germs described) the micrococcus A only, and two the micrococcus C. The other four specimens, one of which contained only the micrococcus A, were obtained from four other individuals.

In addition to the above, one specimen of urine from a person suffering with cystitis was examined. The urine was clouded, strongly alkaline in reaction, and contained a considerable quantity of crystals, principally triple phosphates, pus cells, and amorphous salts. A large number of micrococci were seen in a cover-glass preparation. The bacteriological examination showed that a large number of these were the micrococcus A. Thus far this is the only specimen of urine from an authentic case of cystitis that I have been able to obtain in a condition suitable for a bacteriological examination.

I have also isolated several germs from external sources that are equally as active in the production of ammoniacal fermentation as those already described. Two of these, a bacillus and micrococcus, were obtained from decomposed urine that was previously sterilized and then exposed to the atmosphere of the laboratory by removing the cotton-wool stoppers from the tubes containing it. The sterile, acid urine became clouded and alkaline in from three to five days. A second bacillus was obtained by inoculating a tube of sterile urine with several drops (about 1 c. c.) of Potomac water and allowing it to stand in an incubator, where it became clouded and alkaline in twenty-four hours. The bacillus was isolated from the other germs by means of plate cultures. A micrococcus was also found in saliva which is arranged in fours (tetracoccus) that is very active in transforming urea into carbonate of ammonia. These germs have not as yet been carefully studied, and their isolation is mentioned here in order to illustrate the general distribution of bacteria possessing this property, and to confirm similar results obtained by other workers in this line.

Soluble Ferments.—In the last decade Musculus (9) announced the discovery of a soluble ferment which he obtained from ammoniacal urine that would, when introduced into fresh urine, transform its urea into carbonate of ammonia. The name *urase* was proposed for this substance, as it was supposed to belong to the same class of ferments as ptyaline, diastase, etc. The method of isolating this ferment was reported by Musculus to be one of simple precipitation. The results, however, that have been reported by others who have attempted to isolate this substance have been, so far as I can learn, negative in character. P. Miquel, after a long series of experiments, in many of which the method of Musculus was carefully carried out, concludes with Prof. Leube, that the existence of a soluble ferment in urine is not sufficiently proven to be accepted without further demonstration. Thus far I have made no experiments for the purpose of isolating a soluble ferment. The question whether or not there is such a ferment will have to remain unanswered, together with many other interesting questions that these preliminary investigations have suggested until other and more extended observations shall be made.

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Common Objects Available for Exhibiting the Power of the Microscope.

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To the amateur microscopist it must often occur to exhibit the power of his instrument to friends who are not familiar with it. On such occasions the selection of unsatisfactory objects is most disappointing. The foot of the common house-fly, although a wonderful structure, has been described so often in juvenile literature that the audience is apt to yawn over an explanation of claws and suction disk. So with the circulation of blood in the frog's foot, the rabbit's ear, and the salamander's tail. So with the irrational motions of amœbæ in Potomac water.

It is the unpretentious object of this item to enumerate some other readily obtainable objects for extemporaneous use on such occasions. They require no elaborate preparation and no reagents.

The feathery dust from the wing of the "dusty miller" is, perhaps, too commonly used to need mention. The feet, eyes, antennæ, and wings of cockroaches, bees, wasps, mosquitoes, and butterflies furnish a great variety of wonder-inspiring views.

Often you will be compelled to disappoint some one who expects to see "lots of little bugs" in a drop of well-water, but a drop of slime from the under surface of a lily-pad will fully meet such expectation.

The tail of the newt still remains the most convenient object for showing the circulation of blood. In the same jar where the newts are kept a few sprigs of Chara should be kept growing. The stem of Chara shows cyclosis beautifully. Thin peelings from the bulb of the common onion also show sap circulation well. In cold weather the onion should be kept in a warm place a few hours to quicken the circulation of the sap.

Cross-sections of common woods make interesting specimens. They can be cut with a keen jack-knife, if one has the "knack." Cornus stolonifera, a shoot $\frac{1}{4}$ inch in diameter, makes a good one to begin on, but any soft wood will answer.

Stellate and glandular hairs of plants, the breathing pores of such plants as the white lily, the translucent leaves of mosses, and the pollen of flowers should not be forgotten.

Minute seeds, with their infinite variety of form and marking, are things of beauty and a joy forever. They require a condenser, but no cover-glass. Try the seeds of Arenaria serpyllifolia, and you will be encouraged to seek further. A most delightful series of objects can be easily made from the small seeds of Caryophyllaceæ. The genus Euphorbia furnishes another fine series in which you can often determine the species by the seeds alone. Juncus gives us still another series. In J. effusus and J. bufonius the ribs and cross-lines of the seeds are delicate indeed.

The pappus of many species of compositæ is a charming sight under the microscope, especially when the pappus is plumose, as in Kuhnia, the thistles, etc.

Most of the common grasses have plumose stigmas, which, with their coloring of purple, show finely with objectives of moderate power. The hairy palets of grasses make first-class objects.

Lycopodium, the powder which druggists use to keep pills, etc., from sticking together, will prove of interest and is easy to obtain. It consists of the spores of the common club-moss or evergreen. The spores move over each other so freely that the powder in bulk shakes like a liquid. To the touch it seems like an oily liquid. But under the microscope it appears as innumerable yellow globes, somewhat shrunken and irregular when dry. Any species of Lycopodium will furnish a supply from August to October. The spores of ferns and mosses are equally interesting.

But if you wish to elicit from your audience exclamations of delight, put on the slide a freshly ruptured spore-case of one of the larger Hepaticæ. Marchantia, Asterella, or Conocephalus will answer. The lively way in which the spiral elaters toss the spores about is sure to "bring down the house."

Diatoms you will find in abundance in the stomach of the oyster; but a more convenient source is common polishing powder, which consists largely of their remains.

Raw silk, cotton, and wool, hair, and feathers, are rich spoil for the amateur exhibitor of the microscope. Common drugs, like morphine, quinine, and strychnine—you need not go far for ready-made objects.

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The Seaside Assembly, School of Biology, at Avon-by-the-sea, N. J., opens its eighth session on July 5, 1891, with the following faculty: Dean, George Macloskie, D. Sc., LL. D.; Assistants, J. E. Peters, A. M., D. Sc., A. M. Miller, A. M.; Curator, Mr. D. Watkins. The study of Marine and Terrestrial forms will be taken up, and laboratory practice given. Further information may be obtained by writing to Mr. W. M. Alberti, Sec'y, 142 West 23d St., New York, N. Y.

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The application of the microscope to machine-shop practice, for the purpose of proving whether surfaces are true, is pronounced by experts as being the best method of obtaining accuracy thus far suggested.

EDITORIAL.

General Biology.—In this number we commence a series of articles on the elementary principles of general biology, the various chapters of which will contain constant reference to microscopical work and methods. The articles are by Prof. H. L. Osborn, our former editor, who is at present a professor of biology in Hamline University, and one of the rising men of the day.

The second chapter will be upon the animal and vegetable cell; later ones will be upon tissues as the result of reproduction with specialization of function. The whole matter is likely to appear later in a text-book, and we are allowed to print it thus in advance under copyright, which enables the author to retain ownership of the matter. Our exchanges are not to make use of it in any way except with his consent.

——o——

Koch's Treatment.—The provisional opinions hitherto expressed in this Journal in regard to the value of tuberculin in the treatment or tuberculosis have been confirmed by lapse of time and additional experience.

From the mass of literature upon the subject it is difficult to sift the truth, but we suspect that the truth is something like this:—In lupus and laryngeal phthisis, and surgical tuberculosis generally, the agent promises to be of some value, though it must be confessed that many cases of lupus in which a cure was hoped for or announced still remain uncured. In cases of pulmonary tuberculosis, and in all cases where the tubercular deposit is by its location out of reach of surgical treatment, the new remedy is of doubtful value. Indeed, we fail to see how it could be otherwise, since it is not claimed that tuberculin destroys the bacilli, but only that it produces necrosis of the abnormal tissues in the vicinity of tubercular lesions.

We still insist that all testimony must be taken with the greatest caution. The difficulty of diagnosis in the incipient stage of pulmonary tuberculosis is very great. It is only in this class of cases that benefit is claimed. Therefore even Stricker's eight cases reported cured do not constitute absolute proof.

Koch's own patients are subjected to systematic over-feeding while undergoing the specific treatment. It is more than possible that the improvement in symptoms and the increase of weight and strength are due to pabulum more than to parataloid.

Surgical treatment by resection of ribs seems to us to promise better results than any other method yet practised. Sonnenburg, at Koch's hospital, has treated several cases by this method with apparent success.

Certainly it seems of little profit to produce necrosis of the altered tissues that encapsule a tubercular deposit and are in a measure conservative, unless some means are taken to get rid of the necrotic mass. The bacilli are not killed by tuberculin, and they would simply be left to do their work over again.

On this side of the Atlantic there is a general feeling of disappointment in the result of experiments. It is fair to suppose that some of the "lymph" that has been used here was manufactured outside of Koch's laboratory.

The more belligerent homœopathic journals have been quite jubilant

over the similarity between Koch's tuberculin and their own tuberculinum; but it is doubtful if one in ten of homœopathic practitioners ever prescribe tuberculinum.

The public may at least congratulate itself that sensational journalism has ceased to take much notice of the Koch treatment. This, more than anything else, was responsible for bitter disappointment to many sufferers.

The most that can be said at present is: The value of Koch's method is still problematical. While careful and competent men are performing the thousands of experiments necessary to determine its value, our advice to the general practitioner is: Give your phthisical patients a cool, dry climate, plenty of air, exercise, and nourishing food, and such remedies as will best relieve urgent symptoms.—F. B.

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Photographs Received.—We desire to return thanks to Messrs. James W. Queen & Co., of Philadelphia, Pa., for the following interesting photographs:

Amphipleura pellucida; power, about 1,100 diameters; lines, 98,000 to the inch; by Dr. H. J. Detmers.

Bacillus tuberculosis; in sputum power, 1,000 diameters; by F. E. Ives.

Comma bacillus of Asiatic Cholera, by F. E. Ives.

These admirable pictures were made with the $\frac{1}{15}$ inch oil-immersion objectives, and the workmanship is excellently executed.

TECHNIQUE.

On the Preservation of Natural Objects in Alcoholic and Other Solutions.—The methods are simple and do not differ much from the ways naturalists have ordinarily pursued for years, yet the slight differences mean success or failure.

For fishes. Kill the fish as soon as it is taken from the water by severing the vertebra near the tail. Make an incision near the vent to allow gases to escape and inject alcohol through the vent and mouth. Wash the fish carefully in fresh water and then place it in strong alcohol, the stronger the better, for from four to six days, until the flesh is firm and all slimy matter has exuded. Then wipe the fish and place in the following solution, and it will keep for years if good alcohol be used: Alcohol (95 per cent.), 8 parts; distilled water, 2 parts.

If the fishes are small three or four days suffice to harden them, and the following is a better solution for them: Alcohol, 6 parts; distilled water, 2 parts.

Reptiles, rodents, etc., can be also preserved in the same manner. The first alcoholic bath can be used over and over again, if strained and kept tightly corked.

For the preservation of tadpoles, young frogs, salamanders, and similar objects, take 1 pound sulphate of zinc, 2 drachms burnt alum, and mix well together. Dissolve 1 drachm of the mixture in 42 ounces pure water. Filter; let stand five or six days and filter again. Specimens to be preserved must be hardened in alcohol; then washed in clean water and left to dry until all the alcohol is evaporated; then placed in the above solution and immediately corked.

For larvæ of insects, spiders, and other small delicate objects, take glycerine, 1 oz.; common salt, 1 dr.; saltpetre, 1 dr.; distilled water, 8 oz. Mix.

When wanted for use, take two parts alcohol and one part of the mixture; shake well together and filter.

For delicate objects intended for dissection, the following is recommended, as it keeps the specimens flaccid: Chloral crystals, 1 oz.; distilled water, 5 oz.; alcohol (95 per cent.), 1½ oz.; glycerine, 1½ dr.; rock salt, 15 grs.; saltpetre, 30 grs.

Dissolve the chloral in the water; dissolve the glycerine, salt, and saltpetre in the alcohol; mix the two solutions; shake well and filter. Specimens to be preserved in this solution should be placed in alcohol for a day or two, but if wanted for dissection or only to be kept a few weeks, the alcoholic bath may be omitted.

Keep all specimens away from the light.—*Nicolas Pike in Scientific American.*

——o——

Cleaning Diatoms.—J. J. Moles says, in the *English Mechanic:* Having had a little experience in cleaning a large number of different earths, I have found that each deposit requires a special treatment; but, as a rule. the following will prove useful: First, boil the material in hydrochloric acid for two or three minutes in test tube; allow to settle, pour off the clean portion, substitute nitric acid, of course both pure. Boil again for two or three minutes, then wash well in distilled water in a tall beaker, allowing the sediment to settle; repeat the washing till all acid is removed. Now examine on slide. Should the deposit not now be clean, boil with a small portion of soap; this removes a lot of "flock." Wash again to remove the soap, then decant, and add liq. ammon. fort. for twenty or thirty seconds. Lastly, wash well in distilled water; this leaves the frustules sharp and brilliant.

MICROSCOPICAL SOCIETIES.

WASHINGTON, D. C.—L. M. MOOERS, *Sec'y.*

May 26.—A paper was read by Dr. V. A. Moore on "A method of fixing sections to cover-glasses."

Miss M. A. Booth, Longmeadow, Mass., was elected a corresponding member.

June 9.—Dr. Thomas Taylor read a paper on some recent methods employed by him in the investigation of fats and oils in determining their properties, purity, and adulterations. Among the exhibits was a new mineral fat, of which more may possibly be heard, and a specimen of cloth taken from a mummy embalmed nine hundred and fifty years before Christ.

NOTICES OF BOOKS.

Review of the Prang Course in Form Study and Drawing. By Dr. Arnold Dodel. Prang Educational Co., Boston. Pp. 35.

This pamphlet, which is a translation from *Pædagogium*, Leipzig, bestows very high praise upon the earnest efforts begun in this country

to make drawing one of the fundamental subjects of instruction in the public schools. Teachers and others interested in drawing should examine this critical analysis of the Prang course.

Prof. Koch's Method to Cure Tuberculosis. By Dr. Max Birnboum. H. E. Haferkorn, Milwaukee, Wis. 1891, pp. 105. Price, paper, 75 cents; cloth, $1.00.

Though the excitement attending the announcement of an actual remedy for tuberculosis has somewhat subsided, the literature upon the subject is still studied with deep interest. The present treatise, which is a translation from the German of Dr. Max Birnboum, is a popular treatment of Dr. Koch's method, and is easily within the grasp of all who may feel interested in it.

Catalogue of Microscopes. (Illustrated). 8°, 48 pp. W. Watson & Sons, London, England.

In their new edition of this catalogue Messrs. Watson & Sons have embodied instruments of their own make: Microscopical apparatus, eye-pieces, objectives, mounting materials, micrographic cameras, etc., etc.

Price lists are also included, quotations being given at the very lowest figure for which the articles can be produced. Illustrations of many of the stands, together with their descriptions, are given. Catalogues can be obtained by addressing the above firm.

Microscopic Objects. 8°, 40 pp. W. Watson & Sons, London, England.

This is a classified list of first-class objects affording instructive illustrations in anatomy, physiology, botany, entomology, geology, mineralogy, micro-photographs, and polariscope specimens. This catalogue is intended as a guide in the selection and purchase of objects, and a copy can be obtained on application to the above firm.

Catalogue and Announcement, 1891. Ginn & Co., Boston.

Those conversant with books know the value of the annual catalogue of this firm. The extension of their list in both the elementary and higher departments compels them this year to separate the two classes of books more strictly than heretofore. The firm's announcement for the current year names all of their publications, and gives the prices, with some other particulars of those it does not describe. Any one desirous of keeping abreast of the literature of the day should send for a copy of the catalogue.

Potable Water. By Floyd Davis, M. Sc., Ph. D. Silver, Burdett & Co., publishers, Boston. 12°, 118 pp. (price, $1.00).

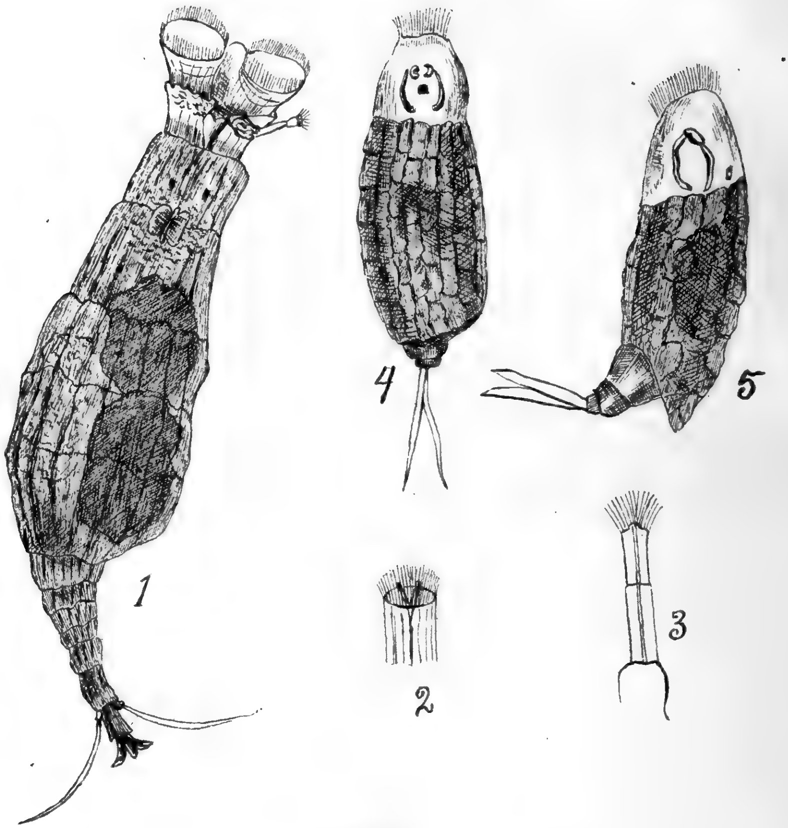
The impurities in drinking water that are frequently the cause of disease and death are discussed here. The natural and artificial processes of removing them from water are also given due consideration. The discussions are clear, compact, and satisfying. They cover well the field of inquiry, and display a thorough knowledge of the subject in hand.

Chapter I treats of pure water, and defines the terms pure and impure, wholesome and unwholesome, from the sanitary standpoint.

Chapter II is devoted to inorganic constituents; Chapter III, to vegetable constituents, and Chapter IV, to animal constituents. Chapter V presents an interesting and instructive treatise on micro-organisms, showing patient study and extended research. Chapters VI, VII, VIII, discuss water supplies, natural purification, and artificial purification, and Chapter IX describes clearly eight different systems for central filtration. An appendix divided into two sections closes the book. Section A treats of the origin and home of cholera. Section B presents four simple qualitative tests for impurities in drinking water.

The importance of the subject will appeal to all intelligent readers, especially such as have in any way to deal with zymotic diseases.

SUBSCRIBERS' NOTICES.



ROTIFERS

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All communications for this Journal, whether relating to business or to editorial matters, and all books, pamphlets, exchanges, etc., should be addressed to American Monthly Microscopical Journal, Washington, D. C.

European subscriptions may be sent directly to the above address accompanied by International Postal Order for $1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

Some New and Little-known Rotifers.*

BY W. BARNETT BURN, M. D.

[WITH FRONTISPIECE.]

PHILODINA TUBERCULATA.

This rotifer, shown in Fig. 1, is of large size, and occurs frequently in pools, yet it is not well known, and I do not think has been figured before. It is curiously like the *Rotifer tardus*, though in important points so different; whereas, though in all essential details coming very near *Philodina aculeata*, in aspect it is quite dissimilar.

In considering the points of resemblance of this species with *Rotifer tardus*, we notice the general outline, the brown color, the deep folds in the body, the proportion of the width of the wheels to the neck, and the habits and movements of both are the same; also the toes are somewhat alike, but here we come to the distinctive character of *Philodina tuberculata*; it differs from all its relatives in its long and slender spurs, and by this alone it may be recognized. *Rotifer tardus* approaches nearest to it in this particular, but the spurs are thicker, and the toes longer in proportion to them; in the former the last joint of the foot comes down over the toes, acting as a sucker, and, in doing so, flattens out, giving the appearance of the animal having four or five toes. Then there is the radical difference of the position of the eye, being in the rotifer in the frontal column and in the philodine in the neck; also, the former has only two teeth each side; the latter, has three teeth on one side, if not on both. Sometimes many will be found having only two teeth on one side. I have counted sixty in succession with this peculiarity, and at other times have seen three on both sides always. Lord Osborne, who specially studied the teeth of rotifers, observed the same variation in *Philodina roseola*, and other observers in other species. It may be a case of knowledge coming and wisdom lingering, the third tooth being cut late in life when versed in the ways of the world.

*Science-Gossip.

Two eyes may sometimes be seen in *Rotifer tardus*, in the neck, just above the mastax, which possibly might cause confusion; these belong to a fœtal animal; but one has to look so far down before one comes to the second mastax that it might be a means of easily separating closely allied species. The head is upwards in *Rotifer vulgaris* and *tardus*, downwards in *Philodina aculeata*, *Philodina tuberculata*, and *Rotifer macrurus*, but is this invariable?

The color of this rotifer varies considerably, probably chameleon-like from the tint of the flocculent deposit in which it lives; some may be found quite a light yellowish-brown; these are the younger ones; in these the internal organs are more easily seen; the mastax is surrounded by a considerable glandular mass, the buccal funnel stands out like a pouch from the front of the animal, its margin fringed with cilia, and leads straight down to the mastax, immediately under which is a large oblong stomach separated by a constriction from a similar shaped but smaller intestine; on the other side an oval ovary fills up the body.

The antenna (Fig. 3) is long, two-jointed, the joint very faintly marked; at the end are three small lobes fringed with cilia. The frontal column (Fig. 2) is rather wide in proportion to its length; among the cilia a small cleft proboscis may be seen immediately before the wheels expand. The tubercules are not well marked, and appear to be formed by the folds of the trunk; in its fully extended state, when it becomes worm-like, resembling *Rotifer vulgaris*, the tubercules almost disappear.

Philodina aculeata, frequently found with the one under consideration, is of a yellow hue, has the distinctive spines, the wheels do not exceed the width of the body, the spurs are small, and the end joint of the antenna is wedge-shaped, base forward.

DISTYLA FLEXILIS.

This rotifer, belonging to the family *Cathypnadæ*, which includes the common *Cathypna luna*, is represented in front view, Fig. 4, and in side view, Fig. 5. Mr. Gosse places it in the genus *Distyla* with some hesitation; there is indeed but little distinction between *Distyla* and *Cathypna*, the former being longer in proportion to width, and the curious lateral, bellows-like, infolding characteristic of the family being less marked.

In this group may be observed something like a state of sleep; the animal perches on its claw-like toes, bent at an angle under its body, and remains motionless for a time, as if visited by that "gentle sleep beloved from pole to pole," which most rotifers seem not to require. The little rotifer has to exercise greater perseverance than the little ant to acquire its daily provender, and, examine it when you may, from morn to dewy eve, or in the silent watches of the night, it is ever in a state of ceaseless activity. This group is interesting from being an exception to this general rule.

Distyla flexilis is small, about $\frac{1}{180}$-inch long and without color, except the one rose-red oblong eye, and a yellowish tinge in the stomach. The body is covered with folds, giving it an irregular tesselated appearance and making the outline fuzzy under a low power. It is active in its attacks on food, but remains near one spot for a long time, occasionally swimming about to seek "fresh fields and pastures new," yet

I have left it under a $\frac{1}{5}$ objective, and at the end of an hour have found it still in the field.

This rotifer separates its toes literally like pincers, and seizes objects between them as if to get a better hold. The one figured came from Wimbledon Common, and was abundant in some water given me by G. Western, Esq.

The Work of the Microscope.*

By P. H. DUDLEY, C. E.,

NEW YORK, N. Y.

At no period in the history of the microscope have the results of its researches received as much attention as at the present time. The importance of the investigations in recent years, by its means, of many of the causes affecting the health and comfort of mankind, is just being recognized by the efficacy of the remedies which have been suggested from a knowledge of the causes. The indications of a new remedy are daily flashed from continent to continent by that unseen agency, electricity, its messages multiplied by the press in all languages and distributed through the land by steam's swiftest trains. These three great inventions of communication and diffusion of knowledge of to-day have carried the tidings to the peoples of all nations, and there is a common interest and thought upon the subject. History does not record a grander spectacle than that of the entire civilized world, brought into sympathy and interest by the investigations of the microscope, in search of relief for thousands of its sufferers from some of the occult conditions incident to life.

Animal or plant life, either of the highest or lowest orders, is surrounded by conditions, some favorable to growth, others unfavorable, and whether an animal or plant will survive or perish aside from the inherent vitality depends upon the preponderance of the favorable or the unfavorable conditions of environment. This law is coeval with the existence of life. To ascertain and understand the conditions favorable to the human race has and will always occupy the attention of a large portion of the more intelligent of mankind.

Some of the conditions are at once apparent; others equally important are unseen, obscure, and only discovered by tracing back from the effect to the cause. We experience effects and not causes, and to analyze the former, assigning each to its proper cause, is by no means an easy matter. The first step is to observe the facts, study their relations, and trace the laws controlling them. It is only in this way that any progress has been made, and then oftentimes the real nature of the cause remains undiscovered.

Jenner's important discovery of vaccination for small-pox a century ago was not the result of an accident as often stated, but close observation of a series of facts and studying their relations. That small-pox was due to a germ in the system invisible to the keenest vision is of recent demonstration by the microscope.

* Annual address of the President of the New York Microscopical Society, 1891, from *Journal of N. Y. Microscopical Society*.

How early minute forms of life were suspected of causing bodily ailments or decomposition in fluids is uncertain. The Egyptians 3,500 years ago knew how to practically prevent decomposition in bodies and wooden utensils, so that they have been preserved to the present time. More recently, Robert Boyle, 200 years ago, expressed the opinion that ferments had something to do with fevers. Leuwenhoek, 1632 to 1723, made small lenses, and described the ferment of yeast as ovoid or spherical bodies, and discovered bacteria in the mouth and in fluids undergoing decomposition. The power and use of the early simple microscopes were too limited to definitely establish the functions of the minute forms or their relations to the higher orders. The belief, however, was becoming more and more general that the minute forms had something to do with bodily ailments and fermentations, but without microscopical aid it could not be clearly demonstrated. As must be expected, some extravagant views were adopted, while others were close approximations to the truth. Boerhaave, in 1693, distinguished three kinds of fermentations, viz., alcoholic, acetous, and putrefactive. Linnæus stated that a certain number of diseases resulted from animated invisible particles dispersed through the air. Spallazani, in 1769, started his series of experiments upon spontaneous generation and sterilization, resulting in the present method of preserving foods. Opinions were very conflicting, and the truth which may now be expressed in a line required years of labor to ascertain, and really follows the improvement in the microscope. In 1837 Cagniard-Latour described yeast as a collection of globules which multiplied by budding. In 1838 Turpin described the yeast plant in beer and named it *Torula cerevisiæ*. Many chemists were unwilling to admit the important part played by yeast in fermentations, and ascribed it to "catalysis," or action by presence. In 1843 the celebrated French chemist, Dumas, from microscopical and chemical examinations, clearly explained the physiological function of the living ferment yeast. The truth was now proven, but it made little progress until Louis Pasteur, some ten years later, took up the work of studying under the microscope the ferments of yeast, vinegar, and wine, demonstrating conclusively that a germ must be present to start fermentation or decomposition in fluids, that the definite knowledge he learned of the functions of the minute forms of life attracted attention.

Pasteur, by his systematic work with his microscope, tracing the life-history of many ferments from the spore, ascertained the laws of growth, so he could induce fermentation or check it as desired. The ability to keep liquids for years when freed from germs, which under ordinary circumstances would ferment or decompose in a few hours, enabled Pasteur to confirm and clearly set forth the general principles of the germ theory of minute forms of life in place of the theory of spontaneous generation. The theory so completed, revolutionizing current ideas, met with vigorous opposition, but the microscopical demonstration was so complete it has proven invulnerable, and upon it has been formed the important branch of science, bacteriology. We are too near to estimate the value of the demonstration. It will require time to show its full value, for its application is but really commenced.

Pasteur's work has been pre-eminently practical, and the results of his investigations at once applied to the French industries, in which

interests they were undertaken. He saved the French silk industries from threatened destruction by investigating the parasitic diseases of the silkworm, and suggested a remedy. His investigations led to the antiseptic treatment in surgical operations which is now considered indispensable. His extensive experiments to obtain vaccines or attenuated virus for protective inoculations have been very successful, especially when the difficulties of producing an attenuated virus are considered.

The process for obtaining the protective virus for rabies may be mentioned. He inoculates a morsel of the brain of a mad dog into the brain of a rabbit, which attenuates the virus sufficiently to act as a protective inoculation for dogs, or men bitten by dogs, suffering from rabies. At first the attenuated virus from the rabbit was also passed through the organism of the monkey before using. This feature has been discontinued. This was the first successful step toward checking rabies. Pasteur has a large institute in Paris for the treatment of rabies, and there is now in this city a branch institute under the charge of Dr. Paul Gibier, where about 160 persons have been successfully treated during the past year.

Considering for a moment the higher orders of plant life, the microscope has shown conclusively that the functions of the fungi which we see upon them is to undo the structure which has been built up by the higher plants, returning the elements composing them to the air and soil. This is of itself a work of great economic value, and must be more generally understood to save our building timber and forests from the natural process of decay.

The rapid advancement of bacteriology in the last decade is largely due to the arduous labors of Koch, who, by extensive microscopical investigations, discovered the specific bacillus of several diseases, particularly of Asiatic cholera and tuberculosis. He originated a method of staining a specific bacillus so as to differentiate it from all others in enclosed tissue or other media, and found them when others not using as skilful methods failed. He originated a system of solid nutritive media for cultivating and isolating a specific bacillus, producing pure cultures. This has proven of the greatest value, for much has been learned as to the manner of growth and products secreted of each bacillus studied. With the pure cultures he carried out extensive inoculations on animals, and carefully noted the effects. The latter have been analyzed, resulting in his extensive experiments with his so-called lymph to check the bacillus of tuberculosis in the human system. It is this feature of Koch's great work which has made his name a household word to-day in all civilized countries.

Yesterday he gave to the world the formula for his great discovery, which, briefly stated, is a glycerine extract of a certain dilution from the ptomaïnes or the products of the bacillus itself.

The consensus of opinion from the tests is that it is a remedy of great value. Besides its direct benefits, the indirect ones will be even greater, for the publicity given by the press to this and kindred discoveries is rapidly educating the people to the important rôle played by the microbes in contagious diseases, and the necessity of efficient sanitary measures for our cities as a preventive. Check the causes instead of dealing with the dangerous effects, and have clean streets, wholesome water, and efficient sewerage. Any one or all of these, when not in proper con-

dition, are efficient media for the growth of microbes detrimental to health, particularly in cities of warm climates. But few of our cities in warm climates have as wholesome water as is needed for domestic purposes, being so filled with germs as to be unsafe for many persons to drink without sterilization. The indifference of the people to these important matters is largely due to the fact that their nature and bearing are not understood. The reasons why the streets should be clean, the water wholesome, and that there should be efficient sewerage in our cities, are evident to health boards, but it needs enlightened public opinion to more thoroughly carry out the demonstrations of the microscope.

The Classification of Diatoms.

By C. M. VORCE,

CLEVELAND, OHIO.

In the very interesting paper of Rev. F. B. Carter in the May *Journal* I notice the omission of all reference to three genera of diatoms, some or all of which are sure to be found in the collections of most beginners who give the study of the diatoms any but the most cursory attention. These genera are *Actinocyclus*, *Amphiprora*, and *Rhizosolenia*. So far as I have heard, the first and last of these are only found in the waters of the great lakes, and chiefly in Lake Erie, but all are *liable* to be found in other bodies of fresh water, and should be included among the fresh-water forms.

Actinocyclus has the typical markings described for the fossil form, with a circlet of extremely minute intra-marginal spines, and is inflated, or kettle shaped. *A. niagaræ* is the fresh-water species, and may be looked for, although it is rare, in the waters of the great lakes from Chicago or Duluth to Oswego, and in the St. Lawrence river.

Amphiprora, as described by Mr. Carter, is best represented in fresh water by the common and widely distributed *A. ornata*, and may be recognized by presenting the shape of the figure 8, or that of a jewsharp or fiddle, according to which side is viewed.

Rhizosolenia, with the characters described, may be looked for in the waters of all the great lakes, and the form *R. eriensis* is often excessively abundant in the waters of Lake Erie.

It seems to me the classification of H. L. Smith would have been preferable to that of the Micrograpic Dictionary, although the latter, if closely studied, will help the beginner to a decision on most of the forms he will encounter.

——o——

A New Bureau.—Secretary of Agriculture Rusk has recently put in working order his new bureau in Chicago for the microscopic examination of hog products for export. He selected a corps of thirty microscopists, fifteen men and as many ladies, and they were set to work under the direction of Drs. John Michels, of New York, and F. H. Bernard, of Pittsburg, microscopical experts. The force will be increased until it is large enough to examine a piece of the diaphragm and of the tenderloin of each hog killed. Those found to be diseased will be condemned.

A Universal Stand.

BY A. G. FIELD, M. D.,

DES MOINES, IOWA.

Fig. 1 below represents a stand adapted to the wants of the professional or amateur who uses the microscope and camera. It consists of base *A*, 14 x 14 x 5 inches, to which is secured, by dovetail, glue, and screws, two uprights, *B*, *B*, 5 x 1 inches, one three and the other seven feet in height. These are precisely perpendicular to base, to bring instruments and object in line when centered. They are grooved on edges to receive tongues or arms *C*, *C*, *C*, *C*, of the secondary base *D*, and also on the camera carrier *H*. The uprights are made firmer by additional pieces extending up thirty inches from the base. The secondary base, 14 x 14 inches, is corner-braced as shown, and is adjustable as to height, being secured in desired position by set screw *E*.

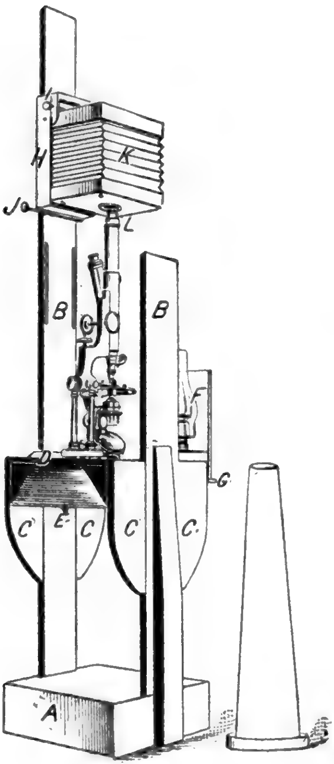


FIG. 1.

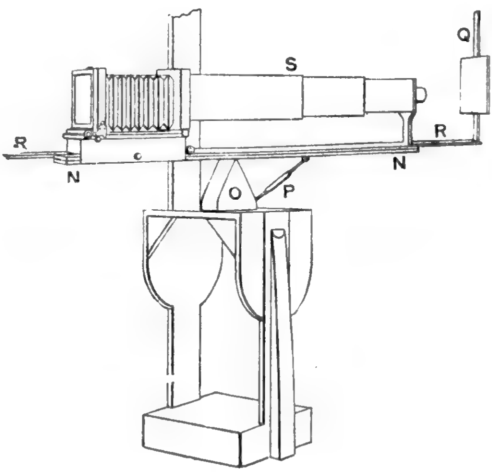


FIG. 2.

In the centre is a hole, one and a half inches in diameter, which receives the tube of the microscope when it is placed on the base for high amplification in photo-micrography, and also the gudgeon of the support of the base-board *O* when used in copying or photography. *G* is a

lamp-rest which slides on cleats attached to the corner braces, and has an upright for concave reflector when desired. *H*, sliding carrier for camera, with tongued arms of sufficient width to bring the photographic lens collar precisely over the microscopic tube when centered on either base. *I*, set screw to retain it in position, and *J*, milled head of pinion by which it is racked down to attach camera, *K*, to eye-piece of microscope. This light-tight connection is made with one-half of child's rubber ball, perforated in centre to fit neck of eye-piece, and of sufficient size to fill the collar of the photographic lens.

Fig. 2 illustrates the use of the stand in copying, enlarging, and reducing, and requires but little explanation. *N*, *N*, base board, 5 x 1 inches, 4 feet long, grooved on edges to receive tongues on arms of camera carrier. It is hinged to apex of wedge-shape block, *O*, the gudgeon of which fits snugly into the hole in centre of supplemental base. *S*, telescopic boxes. *R*, *R*, slat passing beneath the camera carrier, with upright, *Q*, for carrying the picture to be copied, the distance respectively between the lens and picture and lens and ground-glass being regulated by the operator without leaving his position at the focusing screen, so that all copies may be brought to a uniform size, as for lantern slides, without regard to the size of the original. Removing the telescopic boxes and slat, we have a convenient camera stand for inside use, the lateral movements being secured by the gudgeon attachment, and the vertical by the screw brace, *P*.

If used ordinarily as a microscope stand, the instruments are always in line and position for photo-micrography.

Distribution of Diatoms.—Mr. Isaac Robinson, of Hertford, England, says:

"The distribution of the diatomaceæ is much assisted by the swollen condition of our streams and rivers after heavy rains, and in many cases they contribute an appreciable proportion of the muddy coloring matter which the river contains. On the 8th of April I took from the river Lea at Hertford, for the purpose of microscopical examination, one pint of water. The water was at the time much discolored in consequence of there having been a considerable rainfall on the previous day, amounting to nearly half an inch. On carefully examining the solid matter contained in this small quantity of water, I was surprised to find upwards of fifty species of diatomaceæ, some of which were very numerously represented. I should state that these were not such as were simply floating on the river, but that, after agitating the surface of the water, the bottle was filled by placing its neck several inches below the surface. This distribution is further facilitated by dry dust in summer, and what is known as dust storms, in the solid matter of which Ehrenberg detected upwards of a hundred species."

———o———

Staining Sections.—Very fine cellular structures may be rendered plainly visible by coloring them with an ammoniacal solution of carmine, to which a surplus of acetic acid has been added, and afterwards allowing them to remain for two to ten hours in a weak solution of ferric sulphate. This is a very useful method for bringing nuclei into view. The black coloration appears to be quite durable.—*Verhandl. d. Ces. Deutsch. Naturf. u. Aertze.*

Introduction to Elementary Biology.

By HENRY L. OSBORN,

HAMLINE, MINN.

Part II.—The Cell.

(*Continued from page 127*)

Not the least wonderful peculiarity of protoplasm is the multitudinous shapes and associations in which we know it. The bodies of all the higher animals and plants are composed of elements or units called cells, each of which is or has at some time been a minute mass of protoplasm and products manufactured by protoplasm. In their earliest history all cells, however much they grow to differ, are minute globules usually nearly or quite spherical and filled with protoplasm. The cell is coated with a very thin envelope called the cell-wall, the chemical nature of which is the same in nearly all animal cells, and is albuminous, and in all plant cells is starchy. In the centre of the protoplasm there lives a denser body called the nucleus, which is marked off from the remaining protoplasm by a distinct boundary line. The nucleus is composed of protoplasm, but of a kind not wholly like that of the cell at large. The nucleus, the protoplasm, and the cell-wall are thus the component parts of all young cells. Fully grown cells differ very much in regard to the protoplasmic powers they exercise most, some becoming chronic metabolizers, while others are equally habitual in the exercise of the powers of motion or irritability. Cells which thus specialize one or other of these powers have shapes to match, and it thus becomes possible to infer the action of a cell from its shape. Sometimes cells produce by metabolism certain chemical substances which they store away inside the cell-wall, enlarging the wall for the purpose of forming spaces called "vacuoles" in the protoplasm for the reception of these products. Such matter is called "formed" or "dead" matter in contrast with the protoplasm, which is called "formative" or "living" matter. The large bodies of animals and plants are aggregates of cells and of the formed nature which the protoplasm has produced. Since all of these can be produced from gases or liquids it is reasonable that they should be returnable to that state from which they came, and this we know to be true.

Amœba.—We shall do well, if we are to understand protoplasm and its powers and products, to examine some specimen of live protoplasm, for though the chemist is denied the privilege of analyzing living protoplasm, the biologist can spy upon its proceedings for indefinite periods without destroying the substance. One might examine any of a large number of specimens of living cells as our first specimen, but we can begin very well with amœba. This is found in stagnant, slimy, warm fresh water. It is very minute and must be sought and studied with a magnifying power of at least 300 diameters. It has been often described and the reader should consult some of the fuller text-book descriptions. We may briefly say that it is much the shape of a drop of water which has fallen and spread out irregularly. It has a faint translucent border enclosing a finely grained faintly yellowish substance. The granular substance within is active protoplasm, a portion of which, slightly different in character, is the boundary. No distinct cell-wall

exists. The protoplasm surrounds several globular bodies which are found to contain diatoms and alga-spores and other living creatures still minuter than amœba; these globules are called "*food-vacuoles.*" In addition to food-vacuoles amœba presents one vacuole which contains no food, and which now and then shrinks up and disappears, to later suddenly appear again. This is the "*contraclile vacuole.*" One other part is present in amœba but invisible in the living specimen; it is the nucleus. Briefly, then, amœba is a minute drop irregular of outline of protoplasm which presents the following parts, viz: 1. Food vacuoles. 2. Contraclile vacuoles. 3. Nucleus.

Amœba Physiology.—Since amœba is protoplasm we may expect some or all of the protoplasmic powers. What, then, can amœba do? It can move. As you watch it under the microscope you observe a flow among the granules which compose it. Movement results in a circulation within the drop and change in the shape of the drop. The substance flows toward one side and away from the other and the drop thus moves from place to place. In this way amœba glides about and soon escapes from the field of observation unless followed. It can metabolize; this cannot be actually seen, for we cannot observe the molecular structure no matter how well we are equipped with microscopical appliances, but we can infer it, for amœba's substance does not waste away but rather increases in bulk, and oxygen is undoubtedly used up and carbonic acid and ammonia given off, though in too small amounts to be easily detected. It can feel stimulation, and this we can see, for if we make amœba swim between the poles of an electric battery and then send a gentle current from pole to pole, amœba shrinks up into a ball, but presently resumes its motion until it feels a second shock. Amœba protoplasm thus can perform the various acts of protoplasm. The constant activity of amœba may at certain times cease, and later be resumed, and we therefore say that amœba is *automatic* or self-controlling. All living things are thus *self-directive*.

Other Cells and their Powers.—We shall have a better idea of cells by briefly noticing a few other kinds and their powers. A cake of compressed yeast consists of millions of cells mixed with grains of starch. Single cells are oval in outline and are composed of a wall, within which is the protoplasm not filling the cell, but leaving one or more central spaces, "vacuoles," which are filled with water and dissolved chemical substances. If the yeast be thinned with a weak solution of sugar and set aside in a warm chamber for a few hours, it will have produced a certain amount of carbonic acid gas which will give a sour odor and a bubbly look to the fluid, and the cells will have produced buds or smaller cells, which may have in their turn produced still other buds. Here, then, are cells which are actively producing chemical changes or metabolisms, anabolizing sugar, and increasing the bulk of protoplasm, and katabolizing, something which produces carbonic acid, a very simple chemical compound. Yeast cells cannot go on very long producing protoplasm and growing in bulk by budding, unless they have a better diet than sugar and water.

Plant hairs, as, for instance, the hairs on the stamens of the spiderwort or many other plant hairs, are rows of oblong cells with a firm boundary wall of cellulose and within a thin lining of protoplasm, which lining is in communication with the centre where the nucleus lies by

numerous branching strands of protoplasm. In these strands the granules can be seen circulating up and down the strands and out upon the lining. Here, then, we have the second power of protoplasm motion, but not a motion which alters the shape of the cell. Upon the surface of the leaf of Venus fly-trap, a plant which grows in the bogs of North Carolina, there are sensitive hairs, the slightest touch upon which is followed by the instant closure of the two halves of the leaf. Here must be irritable cells. The cells of the potato tuber are very thin walled and in the grown cells the protoplasm has disappeared, and the cells were full of starch, a product of the anabolic power of the protoplasm. The cells of the bean seed-leaf are filled with albumen grains, another substance produced by the anabolic power of cell protoplasm. Plant cells in general are notable for the high degree to which they have specialized the anabolic function, and they can make multitudes of compounds from the simple mineral ingredients of the air and soil. Animal cells on the contrary have in general specialized the motor and irritable functions, though they have by no means discarded the metabolic functions, but in animal the katabolic functions predominate and elaborate compounds enter their body which were prepared by plant cells and comparatively simple compounds leave it.

Resumé.—We, then, are permitted to regard the cell as a being endowed with the powers already considered as belonging to this mysterious substance, protoplasm, and we find that bodily structure of either plants or animal introduces us to these elements operating various of these powers. We shall next consider some of the conditions of cell life and the results of combined effort and division of labor among cells, or, in other words, tissues.

[*To be continued.*]

Examination of Insect Powder.*

By N. J. NITZSCHMANN, Ph. G.

Persian or Caucasian insect powder consists of the flowers of *Pyrethrum carneum* and *P. roseum* growing upon the Caucasian Mountains, at an elevation of about a mile. Dalmatian insect powder is the product of *P. cincrariæfolium*, and it is more powerful than the Caucasian powder. Insect powder does not appear to be poisonous to man, though it is said to cause some confusion of the head in those who sleep in close apartments where much of it has been used.

It has been held until very recently that insect powder owed its insecticide properties to the minute subdivision in which the particles existed, and that they acted mechanically by clogging and filling the air-passages. Late investigations, however, have settled the fact that though the powder does act in this manner to a certain extent, its greatest insecticidal properties are due to a true poisonous principle whose nature has not been positively determined. Some claim that it is an alkaloid, while others say that it is a soft resin. The powder exhausted by means of alcohol is harmless to insects, while the fumes of the burning powder is very destructive to them.

Insect powder has been used as a dressing for ulcers and wounds to prevent the formation of maggots. It also answers to preserve dried

* Read before the St. Louis Club of Microscopists.

insects and plants in cabinet collections. Twenty-five grains of the powder stirred up in two quarts of water were sufficient to kill young cotton worms. The tincture has been recommended by Jaeger as a protective against the bites and annoyance of insects. He declares that in traveling and hunting in Asia and other tropical countries one single application of the tincture over the hands, face, and beard always gave him at least twelve hours immunity from the attacks of all kinds of insects, even white ants, which are the greatest plague of those regions. According to Professor Maisch, it is capable of producing a vesicular eruption like that of poison ivy.

Pyrethrum flowers, grown in and around Berlin, have been experimented upon by Dr. Unger, with the view of determining their insecticidal powers. The *Pyrethrum roseum* was found to be quite efficient, killing in three-quarters of an hour; but the variety known as Caucasian was not so well adapted for use as an insect powder; the insects were stupefied somewhat by it, but rarely killed. *P. carneum* was totally inefficient. Dr. Unger thinks that the first-named variety may be cultivated with profit in and around Berlin.

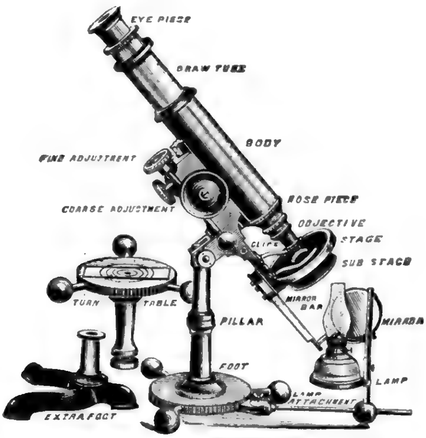
The demand for the powder having much increased of late, it is said to be adulterated with the leaves and stems of the plant, hellebore, turmerie and other adulterants. Some writers claim that hellebore is destructive to insects, but Marpman made a practical test of the value of hellebore as an insecticide. Placing some true insect powder and some flies under one tumbler and imprisoning an equal number of flies under another glass with powdered hellebore, he found that while in a very short time the insects in contact with pyrethrum were paralyzed; after the lapse of twenty-four hours no change could be noted in those in contact with hellebore. I made a microscopical examination of seven specimens of insect powder; two of the specimens were obtained from grocery stores. The method for examination was to remove the color of the powder by means of alcohol, then removing the alcohol and adding a little oil of cloves, and mounting in Canada balsam. I used a one-fifth inch objective in examining the various specimens, and found one specimen to contain starch; by means of polariscope I found this to be potato starch. Two of the specimens contained pollen, while in the other five specimens I was unable to find any. Some of the specimens contained portions of the leaves and stems of the plant. I also examined for hellebore and curcuma, but found none in any of the specimens. Powdered hellebore and curcuma, as found in the drug stores, is a much coarser powder than insect powder.—*Meyer Bros., Druggist.*

Diatomaceous Earth at Montgomery, Ala.—Mr. K. M. Cunningham, of Mobile, Ala., discovered on May 8, 1891, a bed of infusorial (diatomaceous) earth at Montgomery, Alabama. The deposit outcrops in a ravine, and has a thickness of from five to twenty feet. Mr. Cunningham states that vast beds of siliceous pebbles underlie and overlie the stratum. Evidences of plant remains are occasionally found in the stratum, but are friable and very much compressed. This discovery will prove of interest as affording a contrast to the fresh-water fossil deposits of the New England States. As far as we are aware, this is the first mention of a fresh-water fossil deposit occurring in the Southern States.

A Consideration of Some of the Parts of a Microscope Stand, of Interest to Pharmacists.*

By Dr. H. M. Whelpley, F. R. M. S.,
St. Louis, Mo.

There is a constant increase in the number of pharmacists who study the use of the microscope as it is applied to the drug business. This, of course, has the effect of causing a greater demand for instruments which are employed in drug stores. I have sometimes thought that an enterprising manufacturer of optical goods would place on the market a microscope especially designed for the use of pharmacists, or, at least, one that could be advertised as being especially a "druggists' microscope." It is not probable that, as yet, the demand from pharmacists has become sufficiently great to attract the special attention of manufacturing opticians. I do not consider this, as might be expected, a source of regret; for, in reality, the pharmacist does not require a special instrument, rigged with novel devices and decked with new accessories. The needs of the druggists are met by the microscopes which are already in the market. In selecting an instrument, the first thing for consideration is the stand. With a good stand for work, the druggist is ready to add and make use of such quality of optical parts as his requirements may suggest and his means justify; but with a poor stand the possessor is always at a disadvantage, even with the best of optical parts.



Griffith Club Microscope.

The *stand* may be defined as a compound microscope without optical parts. Since the optical parts are the only esential portion of a microscope, and we can do no work whatever without them, this may seem like defining a gun as the portion of that fire-arm without lock, stock, or barrel; but such is not the case. The stand is devised solely for the purpose of using the optical parts to the best advantage. Therefore, any one can readily see that the more perfect the stand the greater the amount of work to be accomplished with the complete instrument,

*Read before the St. Louis Club of Microscopists.

and the more perfect and satisfactory it will be. In considering the various parts of the stand, the above illustration of the Griffith Club Microscope will serve to make them clear:

The *base*, or lower portion of the stand, first attracts our attention. Instruments can be found with bases of almost all conceivable forms, but the only one suitable for druggists is the tripod.

The *feet* forming the tripod may be disguised in the form of the base; but that does not matter, so long as there are three, and only three, points of support. This not only gives the greatest stability to the instrument, with the least tendency to vibrate when the table is jarred, but also has other advantages. One of these feet should always point toward the observer. This is of importance to the pharmacist, who has frequent occasion to incline the instrument while measuring or drawing objects by means of the camera lucida. The only exception to this is when the tripod has two long feet, as shown in the extra foot of the above illustration. In such a case it is justifiable to have the short foot directed from the observer.

The *pillar*, or *support*, requires no special attention. With some instruments it is single, while others have a double support, so that the mirror bar swings between them. Pharmacists are not especially interested in either of them.

The *joint* seen at the upper end of the pillar is a feature of more importance, and every pharmacist should see that his instrument can be inclined to any desired angle. If it is required that the instrument be used upright, it can be so employed just as well as the stiff-backed ones that we still see in the market. However, it is seldom that a druggist has occasion to use an instrument in that awkward position. This joint is usually a single hinge, but it may be secured by means of trunnions, and in such cases is usually provided with some means of tightening or loosening the bearings. Some instruments can be locked with the body at any desirable angle. This, however, is not necessary for a pharmacist's use.

The *arm* is not very prominent in our illustration. It is the portion above the joint, and bears the body. In some instruments it is prominent and closely resembles in form the flexed human arm. If it supports the body firmly, that is all that is required.

The *body* is supported by the arm, and has attached directly to it the optical parts of the compound microscope. The body varies in size and length in different instruments. The size is not of very much importance, but in length it should be what is known as "standard," or be so arranged that it can be lengthened out. The body must be perfectly black inside, and this is best accomplished by means of black cloth. Cloth is more permanent than the blackened metal surface.

The *draw tube* is found only in the better class of instruments, and is a provision for adjusting the length of the body. With very high power objectives it is very essential to have a draw tube. It should be marked to indicate when the body is "standard" length. A great convenience is a "society screw" in the lower end of the draw tube. Pharmacists have frequent occasion to use quite low powers, and if the low power objective is placed in the draw tube there will be plenty of working distance, which I have found is not the case with some instruments. Again, it enables the pharmacist to place the analyzer of the

polariscope in the draw tube where there is no working distance for it with low powers.

The *collar* is the ornamental ring or projection at the upper end of the draw tube, or of the body when there is no draw tube. It is unimportant to the pharmacist.

The *nose piece* is the portion at the lower end of the body. It is provided with a female screw, into which the objective is fastened. By all means purchase a microscope with what is known as the "society screw," so that any ordinary objective can be fitted to it. I have found that the English thread in the "society screw" is not quite the same as the American, and I was obliged to get an adapter for the use of English objectives on an American stand. This nose piece has nothing to do with the double, triple, and quadruple nose pieces, which are accessories, and not a part of the stand.

The *stage* is of importance. The best for the use of pharmacists are made of glass, so that they are not affected by liquids or chemicals. It is an item to have a thin stage which admits of oblique illumination in the examination of crystals. The expensive mechanical stages are very convenient, but not essential for the use of a drug clerk.

The *sub-stage* must be so arranged that it will admit of the use of sub-stage condenser, polariscope, etc. It is hardly worth while for a pharmacist who expects to do much work to purchase a stand without a sub-stage.

The *diaphragm* is a contrivance for regulating the volume of light which is admitted to the object. When a sub-stage is present, the diaphragm is adjusted to it; otherwise it is attached to the stage in place of the sub-stage.

The *mirror bar* and its arrangement is plainly shown in the illustration. All modern microscope stands have the mirror bar so attached that the mirror can be raised above the stage for the illumination of opaque objects. This is a great convenience for the pharmacist who has many substances to examine by reflected light. It is best to have a mirror bar which can be lengthened or shortened as may be required.

The *mirror*, if single, must be a concave one. Where there are two, one is plain and the other concave. As far as the plain mirror is concerned, the size does not make much difference, but the larger the concave mirror the better. Pharmacists can use any mirror adapted to ordinary work.

The *clips* are for holding the slide in position. The ones which can be removed are preferable for a pharmacist who occasionally has liquids to examine, when the clips are in the way unless removed.

The *coarse adjustment* is found on all instruments. The rack and pinion arrangement is the best, and is the one used on the better class of instruments.

The *fine adjustment* or *micrometer-screw* is also a feature of the better instruments, and should be present on every one owned by a pharmacist who intends to do much work. It is much more convenient to have the fine adjustment near the coarse one. By all means avoid the instruments with the fine adjustment on the body near the nose piece. They are inconvenient, and the use of them has a tendency to vibrate the body of the instrument.

As stated above, the ocular, or eye piece, and the objective do not

belong to the stand, so I will not consider them here. The lamp and attachment, as well as the turn-table, shown in the illustration, are ascessories which require special description, not in place at this time.

The American Society of Microscopists.

BY DR. F. L. JAMES,

ST. LOUIS, MO.

This Association, now in the thirteenth year of its existence, will hold its fourteenth annual meeting in Washington, D. C., August 10, and continue in session five days. Its roll of active members contains about three hundred and fifty names. Its membership consists of two distinct classes, viz: professional men and students of the natural sciences, who use the microscope in their daily vocations as an instrument of research, diagnosis, or precision; and amateurs, or those who find pleasure and profit in the revelations of the instrument. Many of the latter class, from having early chosen special lines of study and investigation, have acquired high reputations in their respective departments of microscopical research. In its earlier years this class predominated in the membership of the Society, but at present the professional element is largely in excess.

The qualifications for membership are very simple. The applicant must be a respectable person socially, and interested in the use of the microscope.

The advantages of membership are dual in their nature, *i. e.*, general and social, or those which accrue to the individual from association with others engaged or interested in the same pursuits in any and all walks of life; and special, in that the meetings of the Society are to a certain extent educational in their nature. In the "Working Sessions" experts in every department of microscopical technology are engaged in giving manual demonstrations of the details of their lines of work; in the informal evening "conversaziones" the room of every worker who has anything special to exhibit or demonstrate is open for the reception of all those who wish to witness the demonstration; finally, the soirée affords an opportunity of displaying for the benefit of the members, as well as the public generally, all that is most beautiful, interesting, and instructive in the cabinets or laboratories of the exhibitors. Of late years the soirées have been attended by many thousands of visitors in every city in which the society has met, and have been regarded as distinguished social as well as scientific events.

The dues are trifling, only $2.00 per annum, and in return the member gets a volume of the Annual Proceedings, which costs very nearly this amount. These procedings are elegantly and profusely illustrated with photo-engravings, autotypes, chromoliths, and wood engravings, done in the highest style of art. There is scarcely a subject in the whole range of microscopical work upon which information may not be found by reference to the indexes of these volumes, and collectively they form a library of microscopy full of invaluable matter to the student and worker.

The railroads have of late years extended excursion or convention rates to and from the places of meeting, and, although no arrangements have as yet been definitely made, we can assure our readers that the

Washington meeting will be no exception to the rule. Indeed, it is probable, from the fact of the meeting of the American Association for the Advancement of Science in Washington only three days after our adjournment, that a more than usually advantageous arrangement may be obtained.

The museums and libraries, as well as the many other objects of interest of the National Capital and its surroundings, will be open to the visits of the members, and special facilities for seeing them will be accorded.

Special hotel rates will also be secured. An announcement of the railway fares, hotel rates, etc., will be made hereafter.

In view of the facts related and from assurances that we have already received we are justified in saying that there will be present the largest number of old members of the Society ever in attendance at an annual meeting.

We invite and urge upon all persons, professional or amateur, interested in microscopy and not already on the rolls, to send in their applications for membership to the Secretary, Dr. W. H. Seaman, No. 1427 Eleventh street, Washington, D. C. The application should be accompanied by $3.00, which is the initiation fee and one year's dues. As it is more than probable that the initiation fee will be increased in the near future, it will be to the advantage of all who contemplate membership to send in their applications before the next meeting.

Any further information concerning the Society or the approaching meeting may be obtained on addressing any of the undersigned.

Frank L. James, President, Box 568, St. Louis, Mo.

W. H. Seaman, Secretary, No. 1424 Eleventh st., Washington, D. C.

C. C. Mellor, Treasurer, No. 77 Fifth Ave., Pittsburgh, Pa.

BACTERIOLOGY.

Bacteria in Drinking Water.—Dr. W. Migula (*Centralbl. f. Bakt. und Parasitenk, Bd. VIII, No. 12, p. 353*) makes a contribution to our knowledge of this subject which is really a new departure as regards the examination of drinking water. He points out that, although considerable stress has been laid on the examination of water for pathogenic organisms, there is no reliable rule to guide the hygienist in his examinations for the ordinary saprophytic organisms and their relation to the purity of water to be used for drinking purposes. Dr. Migula washes out small flasks with bichloride of mercury, then, after rinsing them with the water to be examined, he leaves a specimen in the flask, which is plugged with sterilized cotton wadding and covered with an india-rubber cap. It is not necessary to pack the flasks in ice as it is assumed that if any of the organisms multiply they will all do so, whilst if the putrefactive organisms (those that liquefy gelatine) grow more rapidly than the others, independent evidence is obtained of the impurity of the water. Cultivations are made in flat glass dishes in order to save the time required in manipulating plates and tubes during the cooling process. After examining 400 springs, wells, and streams the author has come to the conclusion that where there are

more than ten species in any sample of water, especially when these are not species ordinarily met with, the water should not be used for drinking purposes. He found that only in fifty-nine waters was this the case, but that 169 waters contained more than 1,000 organisms per cubic centimetre, sixty-six of these having over 10,000 (forty over 50,000). From these figures it will be seen that some of the sources of supply would be condemned by the old method but would be passed by the new, and some condemned by the new would be passed by the old. Migula found in all twenty-eight species, and in a series of tables he brings out the fact that the number of colonies does not by any means correspond with the number of species, though in some cases it undoubtedly does so. This is, in fact, an exceedingly variable quantity. It also comes out that putrefactive bacteria are almost invariably absent from spring water; that they are most frequently found where the number of species is great, and where the number of colonies is between 1,000 and 10,000 per cubic centimetre; that they also occur where the number of germs is below fifty per cubic centimetre, but very seldom where the number is over 10,000.

Dr. L. Schmelk, who recently (*Centralbl. f. Bakt. und Parasitenk., Bd. IV, No. 7, p. 195*) pointed out there is a great increase in the number of bacteria in the water supply of Christiana during the period that the upland snows are melting most actively, now (*Centralbl. f. Bakt. und Parasitenk., Bd. VIII, No. 4, p. 102*) gives further evidence collected during the last three years in proof of his theory. The numbers he finds for those years were ten or fifteen per cubic centimeter in March to 2,500 in April, 1888; 1,100 in 1889, and on March 28, 1890, 5,000; the breaking up of the winter snows having occurred this year much earlier than usual. This is the period during which the winter snows are melting, and after this is completed there is no marked increase in the number of bacteria in the lake water until the reappearance of the winter snows, some of the earlier falls of which during October, November, and December melt and disappear. In December the number of bacteria per cubic centimeter sometimes reaches 600, the highest point recorded during the year except in March. Dr. Schmelk thinks that the increase is due to the action of frost in breaking up the earth's surface, from which the contained organisms may be set free as soon as a thaw occurs and then washed away along with the surface soil just as during great rain-storms. He also points out that the masses of ice projecting into a river may form "collecting" points for the particles suspended in the flowing water, as more bacteria are always found in the water obtained from such ice when melted than in the river water itself. He verified this by repeated experiments. He found, however, that when floating ice was melting in water, though it contained a few more organisms than water collected near the surface, it held far fewer than water taken from a considerable depth. In the Christiana water-supply he found some thirty species of bacteria, some of which occurred very seldom, some at certain periods of the year only, and a few all the year round. The amount of solids in the water varies from time to time, between 0.92 and 0.94 grammes per liter, and traces of ammonia can usually be found in water during the time that it contains most bacteria.—*Supp. British Medical Journal.*

Antiseptic Memoranda.—In measure, as our knowledge of antiseptics widens, the fact becomes more evident that each disinfecting agent has its special province, and each micro-organism its peculiar antagonists. One substance alone, namely, corrosive sublimate, is known as a universal microbicide; but its highly poisonous properties and other reasons render the substitution of other antiseptics often desirable. Hence the necessity of a better insight into the exact behavior of each antiseptic with the different germs of diseases. An important contribution to this branch of science has just been made by Drs. Thoinot and Masselin, who have just completed a thorough investigation of the efficacy of sulphurous acid gas as an antiseptic. It should be explained that the experimenters, both skilled and well-trained gentlemen, had at their disposal the resources of the Pasteur Institute microbiological laboratory and the use of some vacant wards at the Charity Hospital. Owing to some of these facilities they were enabled to procure or prepare the various septic agents; to test their virulence before and after exposure to sulphurous gas; to conduct the disinfecting operation under conditions closely similar to those of current practice, and, in fine, to bring into play all the nice exactness now indispensable in scientific researches that are to stand the fire of modern criticisms.

The following were the viruses tested; (*a*) Pasteur's septic vibrio; (*b*) bacterial or symptomatic charbon; (*c*) bacteridial charbon; (*d*) tuberculosis; (*e*) glanders; (*f*) typhoid fever; (*g*) diphtheria; (*h*) Asiatic cholera; and (*i*) Guadaloupe farcy. Each virus was simply exposed to the sulphurous acid in a room of fifty cubic metres capacity, tightly closed with putty. The gas was evolved in various proportions, but the quantity of sulphur consumed noted in all cases. Now as to the results: (*a*) septic vibrio, or Pasteur's septicæmia, was tried under four forms—that is, as bouillon culture, dried culture, serous discharge from a septicæmic guinea-pig, and septic powder. The last, obtained by drying the discharge to the shape of varnish on a glass plate and powdering, is exceedingly virulent. Sulphurous acid gas proved, even in large proportions, utterly powerless in all cases. (*b*) Symptomatic and (*c*) bacteridial charbon remained unaffected, as a rule, though large proportions of sulphur fumes continued for forty-eight hours will occasionally have some effect. (*d*) Tuberculosis in cultures supplied by Professor Nocard, and in the form of sputa, fresh and dried. In all cases Koch's bacillus was found to have been destroyed by a twenty-four hours' exposure to the fumes, in the proportion of 60 grammes of sulphur to the cubic meter (28 grains to the cubic foot). Even in the most refractory form, the sputa, the bacillus will be killed, but the full dose of sulphur is necessary. (*e*) Glanders; cultures of full virulence will be destroyed after twenty-four hours' exposure to the fumes of 60, and even 50 or 40 grammes (28, 23, and 19 grains) of sulphur to the cubic foot. (*f*) Typhoid fever; cultures of Eberth's bacillus from the morbid spleen. Complete destruction after twenty-four hours with 60 grammes of sulphur. (*g*) Diphtheria; cultures supplied by Dr. Roux. After twenty-four hours and 60 grammes of sulphur all Klebs' bacilli were entirely destroyed. (*h*) Asiatic cholera; the only cultures procurable being rather old, the proof cannot be said to be quite satisfactory, yet the bacilli were easily affected by even small doses of sul-

phur. (*i*) Guadaloupe farcy; virulent cultures of this peculiar affection of the ox, obtained from Professor Nocard, were invariably rendered inert after twenty-four hours' exposure to 60 grammes of sulphur, but smaller proportions were unreliable. To recapitulate, sulphur fumes may be considered useless with septic vibrio and charbon. But in 60-gramme doses to the cubic metre, and after twenty-four hours' contact, they may be relied upon to destroy tuberculosis, glanders, farcy, typhoid fever, diphtheria, and probably cholera germs. The germ of scarlet fever remaining as yet unknown, no experiments could be instituted. At the same time this instructive series of discriminating experiments explains why some good authorities speak so highly of sulphur fumes as an antiseptic, while other equally good authorities have pronounced them nearly worthless.—*Therapeutic Gazette.*

Simplified method for preparing Meat-Pepton-Agar.—Mr. N. Tischutkin prepares and filters meat-pepton-agar in the short time of 2–2½ hours. The requisite quantity of agar is placed for 15 minutes in a dilute solution of acetic acid (5 ccm. acid acet. glacial in 100 ccm.). The swollen agar is then carefully washed, free from acid, and then mixed with bouillon. Boiling for 3–5 minutes suffices to make a perfect solution of the agar in bouillon. After neutralizing and cooling down, the whites of two eggs are added, and the mixture placed for half to three-quarters of an hour in a Koch's steamer. It is next filtered through Schulze's paper.—*Jour. Royal Micr. Society.*

Medical Microscopy.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

Methyl Blue Again.—Dr. H. Beyer, of Stapleton, N. Y., writes to the *Medical News* that he has used methyl blue in fifty cases of pharyngeal diphtheria with successful results in all. He applies locally a powder consisting of methyl blue 2 parts and sugar 98 parts.

Milk from Tuberculous Cows.—Bang records some experiments that tend to show that milk from tuberculous cows does not convey the disease, unless the udder is tuberculous. Milk from tuberculous women fed to rabbits did not infect them. Milk from cows with tuberculosis of the udder proved highly intectious when fed to rabbits. Lesions developed in the glands about the pharynx.—*Centralblatt f. Chirurgie, April, 1891.*

Bacilli of Malignant Edema in Musk.—Several cases are on record in which hypodermic injections of tincture of musk have been followed by malignant edema and death. Recent experiments by Dr. J. Van Cott, of the Berlin Hygienic Institute, show that the bacilli come not from the musk itself, but from the animal's bag in which the musk is contained.

Adulteration of Musk.—In connection with the above item, it is well to note a recent chemical and microscopical examination of a sample of "pure Thibet musk," made by Th. Winimel, of Hamburg, and recorded in the *Apotheker Zeitung.* He found it adulterated with starchy matter, vegetable cellular tissue, and water to the extent of more than 25 per cent.

Benzine as an Antiseptic.—In the *Cincinnati Lancet Clinic* for Feb. 7, 1891, Dr. F. W. Langdon extols the virtues of common commercial benzine as an antiseptic and parasiticide. Locally applied, he has found it a cure for tinea versicolor and in furunculosis. It is also the most effective agent for the destruction of the chigger or chigoe. He suggests that it may also be useful, administered internally, in the treatment of trichiniasis. It is very cheap, and the chief caution to be remembered in its use is that its gas is highly explosive.

Methyl Violet for Cancer.—Von Mosetig, at Vienna, claims that methyl violet, injected into cancerous tissue, stops the growth of the cancer cell without injuring the patient. Several cases of complete cure are reported. Now, here is something tangible. Let us have more injections, more facts.

Seibert's Treatment of Diphtheria.—We lately noticed in the Journal the method of treating diphtheria proposed by Dr. A. Seibert, of New York. In the archives of Pediatrics for June, 1891, he reports thirty-five cases treated by the new method, with two deaths. In one of the fatal cases the patient had laryngeal diphtheria, and in the other the treatment was interfered with. In ten of the cases the disease was proven to be genuine diphtheria by finding the Klebs-Loeffler bacillus in the pseudo-membrane.

As before stated, the method consists in the submembranous injection of chlorine water at every point where the pseudo-membrane forms. The effect is prompt and decisive, and recovery is speedy and unattended by symptoms of paralysis. The matter seems to us to merit the most careful consideration.

Counting Tubercle Bacilli.—The Bulletin of the Johns Hopkins Hospital for May and June contains a paper by G. H. F. Nuttall, M. D., on "A Method for the Estimation of the Actual Number of Tubercle Bacilli in Tuberculous Sputum." Lack of space forbids an abstract of the article, and we mention it simply to call attention to the fact that methods hitherto employed are practically of no value.

EDITORIAL.

In another column of this issue appears an extended notice of the coming Annual Meeting of the American Society of Microscopists. This society, which we have seen steadily grow in the number of its members since 1878, the year of its organization, has in view the desirable end of bringing together those persons who have at heart the advancement of all branches of the science of microscopy. It thus exercises a peculiarly instructive and interesting function, and that which it accomplishes, it would be almost impossible to do in any other manner. The meeting of the present year, on August 11, which is to be held in Washington, D. C., promises to be particularly successful.

Within the last few years the National Capital has come to be regarded, and justly, as a city pre-eminently fitted for the holding of conventions. Many people who would hardly be persuaded to attend such meetings ordinarily, with the incidental expense and loss of time from business, would more willingly attend if to the main attraction were joined the important secondary one of a visit to the political centre of

their country. Washington, too, is well equipped in a practical way to insure the comfort of large gatherings of people, and the great number of its hotels and boarding houses, with their consequent competition, is a guarantee that no exorbitant prices will be charged for accommodations. To the microscopist, however, a trip to Washington must prove especially significant. In this city he has access to such scientific depositories as the Army Medical Museum, National Museum, Smithsonian Institution, Department of Agriculture, and the local Universities.

The following committees have been appointed to make arrangements for the comfort of the visiting scientists:

Finance: Mr. J. M. Yznaga, chairman; Messrs. E. A. Balloch, A. B. Coolidge, T. B. Hood, L. D. Wilson, H. A. Robbins, W. C. Duff, D. K. Shute, T. W. Smillie, W. H. Wilmer, and E. A. Burdick.

Reception: Dr. J. M. Lamb, chairman; Messrs. C. H. Stowell, J. M. Stedman, I. W. Blackburn, V. A. Moore, S. J. Radcliffe, C. W. Richardson, R. Foster, A. N. Skinner, H. A. Dobson, and L. M. Mooers.

Place of Meeting and Printing: Dr. Robert Reyburn, chairman; Messrs. Thos. Taylor, W. W. Alleger, W. H. Seaman, C. T. Caldwell, J. M. Flint, H. L. E. Johnson, J. F. Scott, G. B. Young, R. A. Foster, and G. H. Penrose.

Railroads: Mr. H. H. Doubleday, chairman; Messrs. C. Marshall, C. W. Smiley, G. N. Acker, E. A. Gibbs, F. T. Chapman, J. Grimsted, D. S. Lamb, E. G. Seibert, and W. E. Schneider.

An Elegant Slide.—At the May meeting of the San Francisco Microscopical Society Mr. Runyon exhibited a slide prepared by Thum, of Leipzig, and presented by the San Francisco College of Pharmacy to A. H. Breckenfield, in recognition of his valuable course of lectures on "Microscopy" before the class of last year. This slide contained 1,230 diatoms, arranged in the form of a monogram. It was stated that 112 hours of patient labor had been expended in its preparation.

MICROSCOPICAL SOCIETIES.

Boston Scientific Society.

January 27, 1891, 223d Corporate Meeting.—The essayist of the evening was the Vice-President, Dr. Frank Perrin, D. D. S., who read a paper on "Tooth Development." Dr. Perrin's paper was in a measure supplementary to a paper delivered by him at a previous meeting, on the composition of the teeth. He described the gradual development, from the papilla in the primary dental groove to the fully grown tooth, illustrating each stage most thoroughly by lantern slides, nearly all of which were prepared by the lecturer. The paper was very interesting, and treated in a popular way of a subject which is little known outside of the medical profession.

April 14, 1891.—Mr. W. D. Grier read a paper on "The External Anatomy of Insects." Mr. Grier remarked, that although insects make up about four-fifths of the animal kingdom, comparatively few people know exactly what an insect is. An insect is an animal whose

body is built up of a number of hollow, jointed rings composed chiefly of a peculiar substance termed "chitine," having the chemical formula $C_{17} H_{14} NO_{11}$. The rings composing the body are grouped into three general divisions, termed, respectively, the head, thorax, and abdomen. The thorax is furnished with six legs, *invariably*, and sometimes with two or four wings. Mr. Grier threw on the screen a view of a dissected cricket, and described the general topography of the insect. After this he exhibited views of the anatomy, in detail, of the cricket and locust, which insects he selected as being good types of the order in general. After showing the typically formed organs and appendages, he showed the principal variation in form in the more specialized insects which fitted them for their different modes of life. In concluding, the lecturer expressed his thanks to Messrs. F. A. Bates, Wm. Tower, and E. J. Smith, for their assistance in collecting insects for dissection, etc. The paper was fully illustrated with about thirty-six lantern views from Mr. Grier's original dissections. He was assisted by Messrs. Storer and Wilson, who managed the lantern.

April 28, 1891.—Mr. F. A. Bates read an entertaining essay on "The development and habits of insects (including comments on the gypsy moth, and fur and carpet pests), illustrated with the lantern. After a short description of the development of insects, Mr. Bates told about the gypsy moth which has overrun southeastern New England. After discussing the various remedies of spraying the trees with paris-green, etc., he said that the only way to exterminate the pest was to distribute good. colored cuts of the moth among the farmers ; this could be done at a comparatively small cost, and by enabling the farmers to recognize and destroy the adult insect *before* it has time to lay its eggs would more than pay for the trouble and expense. Spraying the trees and otherwise attempting to kill the larvæ and eggs is "locking the stable door after the horse is stolen." as although it is the larvæ that actually *does* the damage, it is the adult which lays its innumerable eggs, each of which will hatch out and produce more larvæ with insatiable appetites for fresh leaves. So by killing the adult we attack the trouble at the root. These moths have already cost the State of Massachusetts many thousands of dollars in the effort to stay their ravages Mr. Bates described the "buffalo bug" and other household pests, and the remedies and preventives: camphor, naphtha, etc., etc. He exhibited a series of these troublesome insects mounted on cards, which were passed around through the audience. After Mr. Bates had concluded, an informal discussion of the subject by the secretary and others took place. Mr. Bates was tendered a vote of thanks by the Society for his excellent paper.

NOTICES OF BOOKS.

Six Centuries of Work and Wages. A history of English labor. By J. E. Thorold Rogers, M. P. Price 25 cents. The Humboldt Publishing Co., New York.

This is the first number of the *Social Science Library*, which puts at the disposition of the public a record that is invaluable. It is the

story of the struggle of the English poor against the avarice of priest and king, landlord and capitalist; a story told by the records of thousands of court rolls and stewards' accounts, compiled by unconscious historians who little dreamed of the tale the figures they so patiently added up would one day be made to tell. From the beginning of the thirteenth century, when almost every one not only possessed land but cultivated it; when a landless man was looked on as an outlaw and a stranger; when the use of the common pasture was without stint, and the arable land of the manor was usually communal; from that remote date to modern times, the motive was the cheapening of labor for the benefit of the monopolist. And surely no time could be more fitting than the present for publication of this work.

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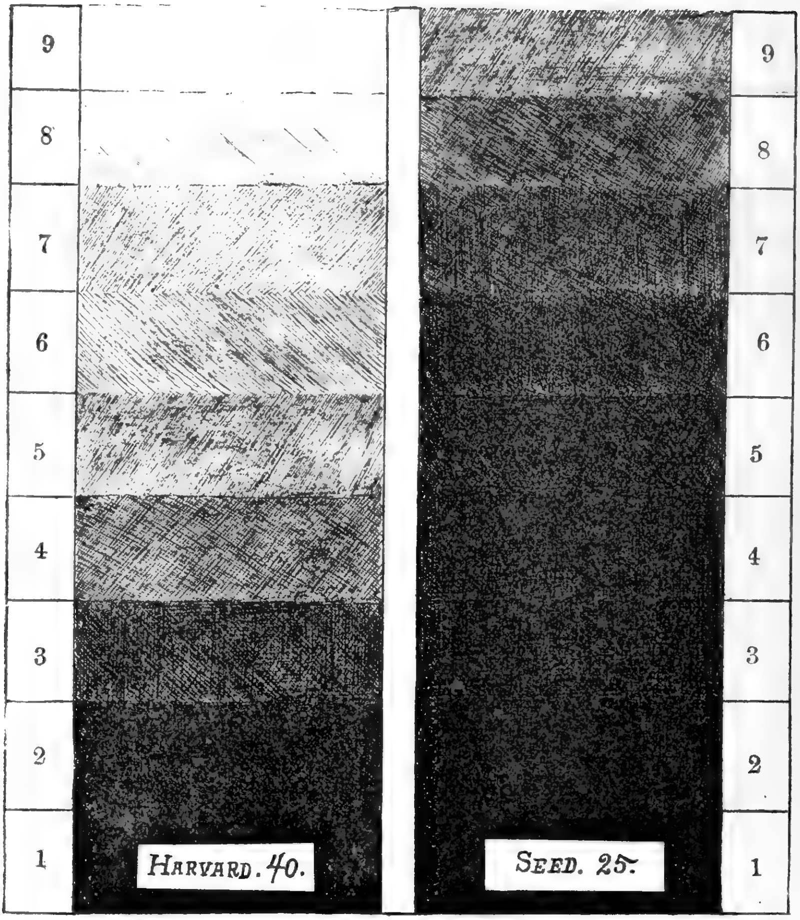

GRADUATIONS OF DENSITY IN PHOTO-MICROGRAPHY.

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The Value of Using Different Makes of Dry Plates in Photomicrography.

BY W. C. BORDEN, M. D., U. S. A.,

NEW ORLEANS, LA.

[WITH FRONTISPIECE.]

While the variation in rapidity of different makes of plates is pretty generally understood and taken advantage of in practical work, the variations of plates in contrast and range of tones are not generally discussed in photographic literature, nor are the great advantages to be obtained by taking proper advantage of these variations understood, or generally practiced. Hardly a photographic journal appears without either some new formula for a developer, or some new method of working an old one, by which it is claimed that some modification of rapidity or contract may be produced in the plate on which they are used. Quite a large portion of photographic literature is devoted to giving these means of producing required effects in negatives, and every box of plates contains information (?) how to obtain greater or less rapidity, or contrast, as may be desired; when in fact, after the light has once struck a plate in a particular way, so changing in a particular ratio, the molecular structure of the sensitising chemicals with which it is coated, but little change in result can be produced by *any* developer, however much that developer may be modified. A modification, however, of the *coating* of the plate, giving a different chemical basis upon which the light acts, will, from the different arrangement and kind of molecules acted upon, produce a different result whatever developer may be employed. It is in this way that variations in result may be best and most surely obtained, for different makers of plates use sensitizing formulas differing in such manner that the coatings, when acted upon by light and "developed" give, results differing in rapidity, contrast, and range of tones. That almost universal advice: "Get a good plate, master its peculiarities, and then use this plate exclusively," is good only so far

as getting a good plate and mastering its peculiarities are concerned, for, however well the working of any one plate may be understood, results cannot be obtained from it alone, upon *all* kinds of objects, equal to those obtainable when different makes of plates are intelligently used, in a manner to make their peculiarities bring out, in the resulting negative, the effect sought for. For instance, if the object to be photographed has but little contrast, and a plate giving great contrast and a short range of half tones be used, a good printing negative will usually be obtained, while. if a plate having opposite qualities were used, no amount of careful exposure or development would give a negative having sufficient contrast to print properly. Similarly, with an object having great contrasts, a plate giving little contrast and long range of tones, will give a negative in which the contrasts of the object are so lessened that printable details are given in the densest parts, while, were a plate having opposite qualities used, the strong contrasts of the object would be so reproduced, or exaggerated that a print devoid of all detail could be obtained only. As in photo-micrography, owing to the peculiar nature of the objects to be photographed, great difficulties are often encountered, the ingenuity of the operator often being taxed to the utmost, it follows that a proper selection of the plate to be used will add greatly to his resources, and will enable him to obtain results which could not be obtained were only one make of plates used, whatever legerdemain of exposure or development he might practice.

But, in order to take advantage of the different properties of different plates, it is necessary to know exactly how they differ; and this must be determined not by exposing the plates to be compared in a camera where the light may be constantly varying, and where the personal equation of the operator may enter as a disturbing factor, but in a manner by which each shall receive equal treatment. For purposes of comparison, I have used a pad of thin white tissue paper (onion skin), 4 x $4\frac{1}{2}$ inches in size, made of superimposed pieces of the paper, each piece being 4 inches long and $\frac{1}{2}$ inch narrower than the next sheet underneath. This pad, when placed on a piece of clear glass in a 4 x 5 printing frame and viewed by transmitted light, gives nine gradations of density from clear glass up. Such a pad answers for all practical purposes, though one $7\frac{1}{2}$ inches long placed in a 5 x 8 printing frame and used with strips cut lengthways from 5 x 8 plates, will give a longer range of gradations. To test two or more plates, a strip about one inch wide and five inches long is cut from each, and placed side by side, film side down, on the pad in a 4 x 5 printing frame. They are then clamped in the frame, exposed for one instant to diffuse day light, or for a few seconds to lamp light; and are then all developed together in the same developer. It is best to develop for fully twenty minutes in a covered tray, with a developer containing a rather large quantity of sodium sulphite. If about 30 grains of the granular sulphite is used to each ounce of developer, yellowing of the films, which might be produced by the prolonged development, will be prevented; and this without any ill-effect on the resulting negatives. Development for fully twenty minutes is recommended in order that development be fully completed, *i. e.*, that *all* the molecules of silver acted upon by light be reduced, for in this way only can the exact properties of all the strips be brought out, inasmuch as some plates develop more rapidly than others, and a stop-

page of development before completion will produce erroneous results. The illustration given with this article is a reproduction of the result arrived at by comparing a "Harvard" plate, sensitometer 40, with a "Seed" plate, sensitometer 25, in the manner above described. It is a reproduction of the negatives themselves (not a print from them), so the lighter bands represent the thinner bands of the original negatives.

The great difference in the two negatives is seen at a glance. The greater rapidity of "Seed" plate is shown by band 9 in the plate, where the light had to act through nine thicknesses of paper before acting upon the plate, being equally as dark as band 5 in the "Harvard," where the light had to act through but five thicknesses. The comparative rapidity of the Seed to the Harvard is therefore as nine to five; or for practical purposes it may be considered as double. The greater contrast of the Harvard, and longer range of half-tones of the Seed are shown by the same range being gone through in five bands in the Harvard, *i. e.*, from band 1 to 5, that requires nine bands in the Seed, *i. e.*, from band 1 to 9. In other words, a certain gradation of light in an object photographed, which will give with a Seed plate a certain contrast in the negative, will with a Harvard plate give practically double the contrast.

This comparison shows at once that the Harvard is the better plate to use when objects having little contrast are to be photographed, or when contrast is desired; and the Seed is the better plate when rapidity is desired, when an object having strong contrasts is to be photographed, or when strong contrasts are to be avoided and a "soft" negative desired. Also, that by the intelligent use of these plates, or others having similar qualities, results may be arrived at which could not be obtained by the exclusive use of either alone.

I have called attention to these particular plates, and have used them in illustration, because they have the opposite qualities, by taking advantage of which almost any microscopic object can be successfully photographed. Not but that there are on the market other plates having qualities in every way equal to the plates particularly mentioned. For instance, the "Eagle" plate, sensitometer 40, is an almost exact duplicate of the "Harvard," 40, in both rapidity and relative contrast; and Carbutt's "Keystone," sensitometer 16, is almost identical with the Seed, 25, in all properties except rapidity. All plates, having the qualities of the Harvard and Eagle, give great contrast and short range of half-tones, and are therefore best adapted to objects having but slight contrasts. With such plates satisfactory negatives can be made from such little contrast, that were plates like the Seed, 25, or Keystone, 16, used, negatives having printing contrast could not be made at all. Conversely, plates having like the Seed, 25, and Keystone, 16, low contrast and long range of half-tones, will satisfactorily reproduce the details of objects having great density or contrast, which details would be entirely obliterated if plates like the Harvard or Eagle were used. As plates similar in other qualities often vary in rapidity, as is the case with the Seed, 25, and Keystone, 16, this variation can be taken advantage of where the light is more or less strong, or where greater or less rapidity is desired, without in any way affecting the result, so far as the printing qualities of the negative are concerned.

I have, however, never found the most rapid plate too quick, even

with low powers and sunlight, as I habitually use a light filter of a color complementary to that of the object to be photographed. For these filters, being generally either yellow, green, or yellowish green; considerably lengthen the time of exposure; so much so, that while with a Zeiss' 2 m.m. h. i. apochromatic objective, a projection eye-piece, 4, and an amplification of 1,500 diameters; a Seed, 25, plate will require about 35 seconds; a wet collodion plate, using a blue filter, would require but about two second.

As the Seed and Harvard plates have the opposite qualities, which adapt them to almost every object to be photographed, before using other makes they should be comparatively tested, either with the plates named, or with some plate with the workings of which the operator is familiar, when their actual qualities will be demonstrated and their adaptability ascertained. Only by such testing can the operator know exactly what to expect, or be able to arrive at the best results, for this, like other work connected with microscopy, should never be of a hap-hazard sort.

The worker in photo-microscopy, who uses plates having opposite qualities as regards density, contrast, and range of tones, and who uses them intelligently, will obtain results which cannot be equalled by the one who uses one make of plates only, or who uses all kinds, as may happen, without a knowledge of their properties arrived at by comparative testing.

——o——

Apparatus for Facilitating Inoculation from Koch's Plates.—Herr W. Prausnitz describes, in *Centralbl. f. Bakteriol. u. Parasitenk. ix (1891), pp. 128–9*, an appararus devised by him for facilitating the inoculation of particular colonies from Koch's plates.

It consists of a metal ring which is screwed on to the microscope-tube. From one side projects a metal piece, in which is left a linear fissue for the insertion of a platinum plate. From the lower end of the plate is excised a triangular piece. The inoculating needle is made to rest in the angle of the platinum plate, its point being about 2 m.m. from the colony. The apparatus is merely intended as a device for keeping the needle steady, so that the special micro-organism only are removed and uncontaminated either by the medium or by adjacent colnies.

Mounting Acarina.—M. E. L. Trouessart finds that dried material containing mites makes better preparations than can be obtained from fresh specimens. The material is placed in a large drop of glycerine on a slide, but not covered. The preparation is then carefully and slowly warmed over a spirit-lamp. By this, the animals are cleared up and freed from air-bubbles and any adherent impurities. For imbedding, glyceria-gelatin is recommended, but if it is desired to keep the animals, this may be done in alcohol or Hautsch's fluid.—*Jour. Royal Micr. Soc., 1891.*

Effect of Corrosive Sublimate on Fungi.—Mr. H. W. Russell states in the *Botanical Gazette* (1890) that glycerine containing 1 part in 10,000 of mercuric chloride does not interfere with the growth of *Penicillium glaucum*, while a proportion of 1 part in 6,000 or 1 in 4,500 entirely stop it. This fungus appears to be somewhat less resistent to the poison than some other forms.

Introduction to Elementary Biology.

By HENRY L. OSBORN,

HAMLINE, MINN.

Part III.—Cell Reproduction.

(*Continued from page 155.*)

1. **General Statement.**—Cells not only have the powers which we have spoken of, but they can, under certain conditions, by various modes, divide into two cells, each retaining the powers and attaining by growth the full size normal to that kind of cell. Thus the cells increase in number. The yeast cell, for instance, developes a small "bud," which rapidly enlarges into a second cell and produces a third, meanwhile the first may have produced another. Colonies of yeasts thus related are the common thing in actively growing yeast. Some cells increase by "fission," that is, by splitting into two equal halves, each one of which at once enlarges to be the normal size, thus doubling the bulk of the cell product. Cells, in the growing tips of any root, as for instance the onion roots, increase very rapidly in this manner.

2. **Details of Reproduction by Fission.**—It is now very well ascertained that the nucleus presides over the process of reproduction by fission. In growing stuctures, as for instance the developing eggs of animals or the rapidly growing tissue of plants, cells can be seen in which at a certain stage the nuclear substance is collected into two separate portions which are no longer round as at first, but in the form of long, uneven finger-like processes starting from a central portion. Such cells are in the first stage of fission. Later, the cell-wall grows down between these nuclei and the protoplasm separates into two portions, the cell walls meet and join, and two cells are produced. This process can be seen in *Amœba* and in many simple animals, as well as in the growth of eggs of the more complicated higher animals.

3. **Results of Reproduction by Fission.**—Fission may split a cell into two halves, which soon separate and have no further interest in each other. Protococcus, the green plant on bark of trees, illustrates this. Here very often the cells remain in contact for a time, but are virtually independent bodies, and the plant for this reason is called unicellular or of one cell, and the fission is called "discontinuous fission." In other cases, the cells may remain connected after fission and "continuous fission." Various forms compounded of cells or "multicellular" may result. *Nostoc* illustrates this where the cells regularly form chains of slightly connected spherical cells. Also *Spirogyra*, when the cells are cylindrical and being placed end to end form long threads or "filaments," and *Oscillaria*, where the cells have motile function. Among animals, many cases occur of unicellular ones, or animals loosely compounded into what are called colonies, as for instance, *Vorticella* and *Codosiga*, and there are some multicellular, as for instance, the *Dicyemids*, which are little more than strings of cells; but the multicellular animals as a rule are a long ways more complex than the simplest multicellular plants like *Spirogyra* and *Oscillaria*. Before considering the results of continuous fission, let us note some of the conditions upon which cell-reproduction depend.

4. **Conditions of Cell Reproduction.**—Yeast serves very well for

observations on cell-reproduction, since it can be handled with ease, responds quickly, and can be easily observed. Slide cultures on gelatine of various moulds, bacterial organisms, etc., are also easily practised in the laboratory, and yield data on the conditions of cell-reproduction. The following are among the more important conditions favorable or unfavorable to the growith of yeast: *a. Food.*—Living cells cannot grow unless they are fed. Yeast, if placed in pure water in a warm place, will bud at first vigorously, but this is because the normal cells are never without a surplus of food, and the reproduction soon comes to a stand-still. If yeast be placed in water and sugar and set in a warm place, the process of budding will go on for a longer period, but will soon be retarded and gradually cease, and the yeast cells die. If, however, a nitrogeneous food be added to these, as for example, ammonium tartarate, the budding process is indefinitely kept up. This fact has important bearings and is without exception in the entire range of nature. All cells do not require exactly the same kind of food, but all cells must have food, and the green plants, like Protococcus, which can live and grow, and reproduce in distilled water are only an apparent exception, for they anabolize starchy and nitrogeneous foods from gases in the water in which they live.

a. Temperature.—Cells do not reproduce well at all temperatures, but they have a minimum, a maximum, and an optimum temperature at which they reproduce. At points above or below the optimum, their activity is retarded; at points of extreme warmth or cold, they are killed. Some cells, as for instance yeast, can endure great extremes of heat and cold—yeast is not killed by an exposure of 10 below zero Fahrenheit for 24 hours, and is not killed by warmth of 212 Fahrenheit applied for only a short time, but is killed by prolonged boiling. The temperature limits vary much for various cells; some algæ can live in boiling springs.

b. Light.—Light does not directly promote cell-reproduction. Yeast will grow in the dark as well as in the light, and egg-cells have to grow in darkness for the most part. *Paramœcium* and other infusoria usually live in light places, but there is no proof that the light is necessary to them, and many cells, as for instance those on the inner parts of animals or plants, live and reproduce in darkness. Though light plays such an important part in living organizations, both plant and animal, it is not necessary as are heat and food to all reproduction. We must, of course, observe in this connection that light is necessary to growth in green plants, but these form do not form an exception to the statement that do not require light primarily for purpose of reproduction.

c. Moisture.—Water is the natural medium for cell life. Many cells bear indefinite dessication, thanks to certain protections they are furnished with, but if they are to reproduce it must be when there is moisture. The power of withstanding drying makes the old style of yeast cakes possible, and also permits the cells of moulds and bacteria to float about as dust in the air, but the germination of these cells, their reproduction by budding or fission, will only go on in a moist place. The cases of plants or animals living in the air are not real exceptions to this law, for the living cells of both these are bathed in fluids, and are killed or suspend animation on exposure to draught.

5. Union with Other Cells.—Among the general conditions of the power of cell-reproduction in some cases at least is the necessity of the union of the substance of two cells. This process has been observed in many widely separate instances, thus the egg-cells of animals and plants must be fertilized. Spirogyra, after a certain interval, ceases reproducing by division, and cell union occurs. Amœba, too, conjugates two amœbæ fusing into one which then divides, and the products redivide in a lively manner. This interruption in the process of cell division has, no doubt, great importance, and some biologists are inclined to regard it as the vehicle, one may say, of inheritance, the two elements bringing their diverse traits together, and fusing them to form a single cell partaking of the nature of each, and consequently not absolutely like either.

6. Summary.—The condition of cell-reproduction may be briefly summarized as: 1, nitrogeneous food; 2, warmth; 3, moisture; 4, occasional union of two cells to form one; 5, light is not primarily necessary to cell-reproduction.

[*To be continued.*]

Micro-Organisms.*

By FLOYD DAVIS, M. Sc., Ph. D.,
DES MOINES, IOWA.

People who have never studied nature through a microscope have but little true conception of the real living world around us. The number of plants and animals with which we are familiar through the naked eye is insignificant when compared with the countless myriads of living bacteria which surround us, and can be seen through a powerful microscope.

The Dutch naturalist, Antonius Van Loenwenhoeck, as early as 1675, observed and studied bacteria, but our knowledge of these micro-organisms has been mostly attained during the last thirty years. In 1848 Fuchs observed these minute bodies in animals dead from septic infection, and in 1849 and 1850 Branell and Davaine observed them in the blood of sheep dead from anthrax; but no efforts seem to have been made to establish any genetic relation between bacteria and disease until Pasteur's work on Fermentations appeared in 1861. Since that date, remarkable and interesting discoveries in bacteriology have been made by Pasteur, Koch, Klebs, Cohn, Virchow, Burdon, Sanderson, Tyndall, and many others, from whom we have been given convincing proof of the validity of the "germ theory of disease."

It is now almost universally admitted that bacteria, or microbes, belong to the domain of botany, and are the simplest and minutest organisms in the vegetable kingdom. The great majority of these micro-organisms are harmless to the human system, and are beneficent agents in nature; but some of them are infectious, the diseases that they produce being called zymotic, in consequence of their course resembling a process of fermentation. Such diseases as cholera, typhoid fever, diphtheria, scarlet fever, and erysipelas belong to this class.

As long as the cause of these diseases was undetermined, the science

* From *Potable Water* by permission of Messrs. Silver, Burdett & Co., publishers, New York.

of their medical treatment was groping in the dark, and it is only since the genesis of many of the most dangerous diseases has been traced to micro-organisms that the right treatment of them has become probable. The announcement that Dr. Robert Koch, of Berlin, has discovered a method of inoculation, by which all except the most advanced stages of tubercular consumption can be cured, has given an immense stimulus to scientific medical experiment, and it is hoped that his discoveries may be carried to all stages of this dreaded malady. Consumption and malaria are two of the most dreaded microbe diseases with which the human race is afflicted, and the discovery of the means of curing them, and preventing their spread, will undoubtedly be the greatest benefit to humanity that medical science can give us. For it is said that owing to the exposure which soldiers are compelled to undergo, one-half of the deaths in the German army are caused by tuberculosis; and if medical statistics are true, malaria, in all its direct and indirect results, is held accountable for at least one-half of the mortality of the human race.

Since these are microbe diseases, it may be well to state briefly a few facts concerning the germs of disease. Many bacteria are not more than one-fifteen-thousandth or one-twenty-thousandth of an inch in length, and it has been estimated that it would require four hundred million of them of average size to cover one square inch of surface.

Bacteria are present in many kinds of matter. They always inhabit the air we breathe and the food we eat, and even the purest natural water is never free from them. A cubic centimetre of average spring or deep well-water generally contains from several hundred to several thousand of them, while a single wine glass full of polluted water is often found to contain more bacteria than there are people on the face of the earth. Bacteria are indeed so abundant in nature and so difficult to separate from living tissue, that when our fingers, even after a thorough washing, have been brought in contact with the biologists sterilized microscope slide, a dozen or more groups of them can be cultivated from it. And they are the most prolific organisms of which we have any knowledge, for in its multiplication a single bacterium may become the causative parent of sixteen million five hundred thousand descendants in a day.

Bacteria are classified according to their shape and structure. Thus the micrococci are composed of single, spherical, or oblong cells; the strepticocci are composed of cells arranged in chains; the bacilli are rod-like forms, while the spirilla are of a corkscrew or spiral shape.

Although our most dreaded diseases are produced by bacteria, the harmless forms of these micro-organisms have their beneficent uses in the economy of nature. Through their efforts sugar is converted into alcohol, and from the carbonic anhydride evolved, the cork of the champagne bottle is discharged with almost explosive violence. While one class is thus engaged in making alcohol, another class is fermenting it into acetic acid; and still other classes are servants to the baker in raising his bread.

It is to bacteria that we owe the phenomena of fermentation and decay. They are the common scavengers of the earth. It has long been known that plants and animals bear a reciprocal relation, each producing the food that is required by the other. Plants take up simple com-

pounds, like water, carbonic anhydride, and ammonia, and elaborate them into complex compounds suitable for the food of animals. Animals, on the other hand, break down these complex substances and furnish them again in the simplest forms available for plant food; but still there is a large number of animal products that are not thus reduced, and not suitable for plants to assimilate. "These it is the function of the bacteria to transform and prepare. They are the cooks of the vegetable creation. Every fermenting manure heap, every rotten vegetable and animal is a great kitchen in which this preparation of vegetable food is going on. But for the constant beneficent work of the bacteria the world would soon be choked up with the undecomposing remains of plants and animals; and vegetable and animal life must alike perish. They are at once, then, the scavengers, caterers, and cooks of nature, and as no living beings are so widely distributed, so no living beings are more beneficent in their work."*

In an interesting investigation at the city of Paris, it was found that in a cubic metre of air above ground there were ten thousand germs; in the sewers, thirty-six thousand; in old houses, forty thousand, and in the hospital of Petie, seventy thousand. Dr. Percy F. Frankland has also shown that the number of bacteria present in the air differs at different seasons of the year, the largest number being found during the summer months.

These micro-organisms are absorbed by water exposed to the air, and Dr. Frankland has found that the average river water of England, like that of the Thames, contains about twenty thousand germs per cubic centimetre. This number is greatly reduced when the water is submitted to storage and filtration, for the purified water from the Thames, used in London, contains only about four hundred germs per cubic centimetre; but there is, perhaps, no reliable artificial method for their entire removal, except by the agency of heat, and by slow filtration through compact substances.

The bacterium termo, which is the agent of putrefactive decomposition, is found abundantly in polluted water. If a bottle of such water be left in a warm place for a few days, the water acquires a disagreeable odor, and upon microscopical examination is found teeming with these micro-organisms and other low forms of life. Or, if a glass of the water is left uncovered for a few days, a thin coating will form on its surface, which, if placed under a microscope with a magnifying power of about five hundred diameters, will present an interesting field. In the words of Troussart, "The whole field of the microscope is in motion; hundreds of bacteria, resembling minute transparent worms, are swimming in every direction, with an undulatory motion like that of an eel or snake. Some are detached, others united in pairs, others in chains or chaplets, or cylindrical rods." These bacteria multiply and develop in endless succession, in accordance with the laws of their being, and they are significant of organic pollution. They purify water, however, by converting the organic into inorganic, and therefore harmless constituents. But a water which contains them in any great numbers should always be considered with suspicion.

In some instances bacteria are capable of being conveyed to great distances in water without losing the vitality necessary to produce fer-

* *The Sanitary Era*, March, 1890.

mentation or disease. Indeed, it is a very difficult matter to deprive some bacteria of their vitality ; they may be frozen or even heated to the boiling point of water, and yet many of them are not destroyed. They may be kept dried for years, and yet, when in a favorable medium, if pathogenic, are capable of producing disease.

Wherever bacteria are found abundantly, decomposing nitrogenous organic matter is always present, and Pasteur has shown that they do not multiply without a putrefactive environment, but remain infertile until they perish. Bacteria of putrefaction and infection flourish most abundantly in a neutral or an alkaline menstrum, such as is generally found in decomposing sewage matter and the effluvium from sewers; but they are readily destroyed in acid solutions. It has also been observed that the bacteria producing acid fermentations perish in alkaline liquids.

Standard authorities agree that alkaline waters are dangerous for drinking, since they may favor the development of infectious germs. Water that contains an excessive quantity of the alkaline carbonates tends to make the system alkaline, and physicians often find it necessary to put patients suffering with digestive, intestinal, and renal diseases, upon distilled water as a beverage, and with happy effects.

The infectious bacteria are liable to multiply rapidly on alkaline mucous membranes. This is the case with the micrococcus of diphtheria, when carried into the air-passages. The only guarantee against this disease is isolation from the micro-organisms that produce it. What is true of the air-passages is also true of the alimentary canal, for in persons afflicted with digestive disorders, in which the gastric juice is constrained, pathogenic germs may find a fertile soil and multiply with great rapidity. In the healthy human stomach infectious germs do not thrive, as the reaction therein is acid; a free supply of gastric juice will kill and digest them.

A good corrective for alkaline polluted waters is sulphuric or phosphoric acid. These acids arrest putrefaction and destroy the germs. Workmen, whose employment, location, and habits, favor an attack of a zymotic disease, sometimes prevent an epidemic by drinking water acidified with one or two drops of sulphuric acid per pint. Sulphuric acid is also used with great advantage in treating cases of cholera and typhoid fever, by giving ten to thirty drops of the acid in water three times a day. Owing to the power of certain reagents in rendering bacteria latent, or in destroying them, there has arisen in modern medicine this antiseptic method of treatment. Hydronaphthol is also recommended as a corrective for polluted water; it is a powerful germicide, but it is harmless to the human system. Pyridine, a constituent of tobacco smoke, is also a powerful destroyer of bacteria. It is claimed that men who use tobacco are less susceptible to zymotic infection than those who do not use it, and that women are more frequently attacked with typhoid fever and diphtheria than men. If this be true, it is, however, more likely due to the sex than to the antiseptic agent used.

The infectious bacteria are thrown off with the excretions of persons suffering from zymotic diseases, and these germs not infrequently find their way to water supplies, and therefore to persons who, from predisposing causes may be in a suitable condition for their reception and multiplication, and for the production of a specific form of disease;

but unless a suitable lodgment is found for the germs, no disease will be produced by them. From the experiments of a distinguished investigator, it has been shown that the human body has enlisted in its service what may be called a microscopical militia, whose duty it is to ward off the assaults of the invading microbes. These militiamen are the lymphatic cells, whose function in part is to swallow or annihilate the hostile bacteria before they enter the blood. Where, of two persons exposed to the same contagion, one escapes and the other falls a victim, the explanation lies wholly in the fact that in the one case the sentries are victorious, while in the other they are defeated in their struggle with the invading bacteria.

In the language of the "germ theory," certain constituents of the system are exhausted by the infectious germs, and until they are restored the body is protected from any further attack of the same disease. To exhaust the system of this nidus, a germ less vigorous and dangerous than the disease-producer will sometimes suffice. If, then, after feebler organism has exhausted the system without fatal results, the virulent germ should find its way into the system, it will be harmless. This is the whole secret of vaccination.

A very interesting and valuable fact has been brought to light by the experiments of a distinguished European writer, who has shown that sometimes "two micro-organisms, either of which singly is harmful to the human body, may be deadly foes to each other. This was found to be true of the microbes of diphtheria and erysipelas. Of a large number of persons afflicted with diphtheria, all those who were inoculated with erysipelas recovered, while those not so inoculated, died. It was noticed that those who recovered from diphtheria had only a very mild form of erysipelas, as if the microbe peculiar to that disease had been exhausted in the conflict with his diphtheria enemy."

Each group of pathogenic bacteria seems to have its specific organ for attack. Thus the *Bacillus tuberculosis* generally has its seat in the lungs; the typhoid bacillus penetrates the mucuous membrane of the intestines and accumulates in the spleen; and the micrococcus of diphtheria produces extensive layers of false membranes in the fauces. We are, therefore, to assume that each zymotic disease is accompanied by its specific germ; and that each germ produces only its own kind. The doctrine that "like produces like" continues eternally true, but there may be a gradual change produced by a change of environment. If we sow wheat only, we do not reap a crop of oats or barley; but just as wheat springs from wheat, so each zymotic disease has its accompanying distinctive germ. And so, if we plant only cholera germs in our system, we do not reap a crop of small-pox or measles, but invariably a crop of cholera.

Bacteria have the power of elaborating organic poisons, known as Ptomaines, and the question as to whether zymotic diseases are the direct result of the action of pathogenic bacteria upon certain organs, or the result of Ptomaines elaborated by them, cannot in the present state of knowledge be answered with certainty. In some cases, however, the disease seems to have come from the organic poison. Tyrotoxicon is the poison produced in the fermentation of milk by the agency of bacteria, and it seems to be the cause of much sickness originating from spoiled milk. It produces a complexus of symptoms in the

human system resembling those of cholera infantum, and Dr. V. C. Vaughn, who discovered this poison, suggests that this may be the chemical irritant producing this disease. And what is true of cholera infantum is perhaps true of typhoid fever, and many other diseases, but not at the same stage of life.

While some persons are easily infected, it is also true that many seem insusceptible to the germs of disease, and, although much exposed, they pass through long lives unscathed. "This insusceptibility varies indefinitely, or it may exist at one period of life and then unfortunately be lost, or a new and greater susceptibility be acquired at other times. The conditions that determine susceptibility or insusceptibility cannot be defined in the present state of knowledge. There are certain periods of life when the human body cannot be infected—infantile period, old age. At the extremes of life the typhoid germs can make no impression, because of the absence of necessary conditions. The essential lesions to constitute any one case of typhoid, are thickening, ulceration of the glands situated in the lowest part of the small intestines (Peyer's patches), and similar changes in what are known as the 'solitary glands.' At the earliest period of life these glands are not sufficiently developed, and in old age they are too much wasted, to furnish a nidus for the reception and growth of the parasite. It is not possible to indicate the precise period when these glands acquire full development, or become too much wasted to take on the typhoid infection.* "

Bacteriology is the newest of the sciences, and yet it has become one of the most interesting fields for the truly scientific investigator. No chemist and no pathologist can afford to remain ignorant of what has already been learned of the workings of the microscopic world around us, for many of the most interesting chemical changes are produced by bacteria, and many of the most dangerous maladies have been traced to them.

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Japanese Filter Paper.—The Japanese filter paper so commonly used for cleaning objectives, etc., appears on microscopical examination to consist of very thin-walled bast fibers. By comparison with other papers, Dr. Uloth was able to identify it as derived from the shrub Wickstroemia canescens, which grows in the mountains of Middle and South Japan. The plant belongs to the same botanical family as the Mezereons of Europe. The paper goes under the name "Usego."—*Pharmaceutical Record, March 26, 1891.*

Introduction to the Study of Mosses.—*Popular Science News* for March, 1891, has a posthumous paper from the pen of the late Prof. Leo Lesquereux, entitled the General Character of Mosses. It was originally prepared for the Manual of the Mosses of North America, from which it was omitted to save expense. We regret the omission, and call attention to this publication, because thus far little, if anything, of the kind has ever been published in America.

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* Report of Iowa State Board of Health, 1889.

Some Observations upon Insect Tracheæ.

By Dr. EDWARD GRAY,

BENICIA, CAL.

"Opposed to the general opinion of anatomists since Sprengel, the tracheæ are not composed of a double membrane with a spiral fibre between them, which may be rolled up by itself; but the spiral fibre is only the result of the thickening of the inner membrane. * * * The inner surface is not formed of a mucous membrane, and shows no cells; it corresponds to that of the wings, and may indeed *show hairs or prickles* like the external coverings and membranes. In fact, these epidermal appendages * * * prove at once that the spiral thread is raised internally, and that it actually forms a part of the inner membrane."

Who is it who thus speaks with authority, and sets at naught the teachings of the books? It is no less a writer than Dujardin, and the original of the quotation appeared in the *Comptes Rendus* for 1849. It is therefore remarkable that these statements, if correct, have not long ago been duly incorporated into the text-books. That Dujardin is right is not difficult to prove when one will examine for himself. First, very recent authorities, such as Graber and Lowne describe the structure of the trachea similarly to Dujardin. To quote from Lowne only: "The main trunks and larger vessels exhibit an external coat of thin polygonal cells closely united by their edges. * * * Internally to these cells there is a thick cuticular intima, with a distinct spiral structure, which gives the vessels their well-known appearance. In the smaller tracheæ the intima is apparently structureless." ("Blow-fly" revised ed.)

Graber's statement tallies with this, and these writers, be it observed, are practical insect anatomists and physiologists and original observers.

Second, the intelligent microscopist may demonstrate the matter for himself. It is, to be sure, a problem of some delicacy, and not to be solved by off-hand and careless methods. Still, the average observer need not feel unequal to the task. No result will be attained by soaking or boiling the trachea in caustic potassa and mounting in balsam; every vestige of epithelium, external or internal, will assuredly be destroyed in this way. Fresh specimens only, examined in fluid, are fit to decide such a question. Inferences from ordinary balsam slides, in particular, are not to be trusted except as corrected by fresh untreated specimens. Quite recently a tracheal trunk from a beetle—species unknown—with no other treatment than carmine staining, showed the polygonal cells clearly with the spiral intima, but with no internal membrane. Very commonly, however, the inquirer will find it not easy to demonstrate the epithelial layer.

Dujardin's words are of interest in another direction, for Mr. F. Dienelt lately re-discovered the intra-tracheal hairs mentioned in the quotation, and editorial mention was made of the fact in *The Microscope* for August, 1890. It certainly appears remarkable that with the improved instruments of modern days a period of forty years should have passed before the re-discovery of these hairs. The largest development thus far known occurs in a water scorpion of the Nepa family, named *Zaitha flaminea*. In this insect the intra-tracheal hairs are not distributed everywhere, but only in certain of the larger trunks.

Moreover, and this is an original and novel observation of Mr. Dienelt, in those larger tracheæ of the water scorpion which are devoid of hairs there are instead a series of rounded or irregularly oval spaces in the spirals thus: -◎-. Whether they occur in any other tracheæ is not yet known. The Belostoma, a relative, shows neither these nor the hairs in its tracheæ.

The intra-tracheal hairs have been verified thus far in only some half-dozen insects, while Dujardin's list is much larger.

What purpose these intra-tracheal hairs can serve is not clear. Mr. Dienelt offers the explanation "that they are used in oxygenating the blood acting through their walls similar to the action of the capillaries in our lungs. The surface exposed to the air in the tracheæ is immensely increased by these tubes."

Plausible though this may appear, the theory is open to weighty objections, but these I refrain from advancing now without further investigation and greater presumptive proof.

Again, what appears to be quite a new discovery by Mr. Dienelt and a curious fact is that in certain instances the spiral structure of the tube may be interrupted, and the missing turns be replaced by a membrane beset with hairs. This is shown upon a slide from a wood-boring lepidopterous larva which the observer kindly forwarded to me. The band in this instance is of a breadth equal to six or seven of the spirals, and the intra-tracheal hairs are strictly limited to this band. In this instance, then, these bodies can have little or nothing to do with aeration of the blood. The same characteristic is likewise shown upon a slide of tracheæ from the silk-worm in my cabinet. Other observations will be required to indicate the physiology of these hairy bands, for thus far they appear devoid of muscular fibres. Are they, perhaps, like elastic tissue?

Enough, it is hoped, has been here recorded to show that the commonplace tracheæ are still a field fit to yield new fruits to the studious observer.

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Collecting Specimens on the Desert of Atacama.—Our botanical friends will find delight in an article in the February number of the Bulletin of the Torrey Botanical Club, from the pen of Thomas Morong, written in his happiest style. It describes a collecting trip to the Desert of Atacama. Particularly worthy of note are his remarks upon the adaptation of plants to an almost rainless climate. These desert plants develop an immense number of seeds. The seeds have a very thick coat, which, nevertheless, softens readily under the influence of moisture. Bulbs are so juicy that the juice can be squeezed out in a stream by hand. Plants begin to bloom and fruit at a very early age. Finally, the shrubs shed their leaves in the summer instead of the winter, thereby reducing their vital expenditure to a minimum at a season when they need to husband their utmost strength in order to resist long continued dryness.

Personal.—Dr. H. M. Whelpley, F. R. M. S., has been elected Professor of Physiology and Histology and Director of the Histological Laboratory of the Missouri Medical College. The doctor is also Professor of Microscopy in the St. Louis College of Pharmacy and Editor of the *Meyer Brothers' Druggist.*

Some People in Washington Who Work with the Microscope.

BY F. BLANCHARD, M. D.,

WASHINGTON, D. C.

In preparing this unpretentious article, the writer has spent some delightful hours among the microscopists of this city. To say that he has everywhere met the utmost courtesy and cordiality is speaking very mildly. Everywhere he has been obliged to tear himself away from wonders of beauty and skill, patiently and gladly shown to him. Thank you, one and all, ladies and gentlemen.

Probably no other city on this continent can present such an array of microscopes and skilful workers therewith as this city of the Capital. It is not proposed to give in this paper a complete list of our microscopists, but simply to mention some of the busy workers, and tell what they are doing just now. Many of them are not known distinctively as "microscopists," and are inclined to disclaim the title. As one of them expressed it: "The microscope is simply one of my tools."

Our first visit was to the Army and Medical Museum. Here in an upper room Dr. Gray revels amid stacks of slides, culture tubes and cameras. Just now he is at work on fœtal sections and photographs of the same. Doubtful if those photographs can be matched to-day on this planet. He has a good word to say for Koch's tuberculin. At the National Museum was Curator George P. Merrill at work in micrographic petrography; Naval Surgeon J. M. Flint, with a splendid collection of deep-sea Foraminifera, exhibited on a most igenious rotary stage of his own construction, and an equally ingenious slide-carrier, consisting of an endless band holding scores of standard slides; F. H. Knowlton at work on paleo-botany and the internal structure of fossil plants, and Theodor Holm, once a Dane, but now a good American citizen, doing fine work in vegetable morphology and anatomy. His drawings are very delicate and true.

In the Agricultural Department everybody uses the microscope. Miss Carrie Harrison has done some good work on the marine Algæ; Mr. Rose pores over the Compositæ, and Prof. Holzinger is doing some good work in private on the mosses. Prof. Galloway is authority on vegetable pathology, and his assistant, Miss Effie Southworth, can show as good mounted specimens as can be seen anywhere. Miss May Varney deals with Fungi sent in for identification. D. G. Fairchild has for his specialty the diseases of nursery plants; W. B. Waite, the pear blight; Erwin F. Smith, the peach yellows.

Here, too, is Dr. Thomas Taylor, President of our Microscopical Society, noted for his work on the microscopy of animal fats. He is also an authority on the Agarici. Just now the tensile strength of fibres is occupying his attention.

Dr. Theobold Smith can tell you all about pathogenic microbes. At present he is working on the germs of Texas fever.

Miss Ellen Cathcart works upon the mosses, and Mr. G. B. Sudworth on the microscopy of woody plants.

To readers of the *Journal* we hardly need mention the name of Dr. V. A. Moore, who carries on his studies in bacteriology at the Agricultural Department.

At the Geological Survey building, we had barely time to gather the

names of those who are using the microscope on thin rock sections. These are J. P. Iddings, Arnold Hague, Whitman Cross, G. F. Becker, J. S. Diller, and J. Stanley Brown.

At his desk in the Patent Office, we had an interesting chat with Dr. Wm. H. Seaman. His specialty is cryptogamic botany, and he has a fine herbarium; but just now his microscope is directed to the light-giving apparatus of the fire-fly.

At the Bureau of Internal Revenue, Prof. Edgar Richards has charge of a very fine instrument, which, with its accessories, cost something like $1,200. It is used in examinations for food adulteration.

In the U. S. Fish Commission, of course, the bulk of microscopic work is done at the stations on the coast or on shipboard. Here the principal work that requires the microscope is the identifying of minute forms of marine life, and studying the diseases of fishes. Dr. R. R. Gurley has just been taking a course with Dr. Gray, preparatory to studying the fungi that attack fishes. Mr. Richard Rathbun has for a specialty, free-swimming and parasitic Copepods. Dr. H. M. Smith is interested in the microscopy of blood-stains, and in general histology. He is assistant to Dr. Blackburn, at Georgetown University. Mr. James E. Benedict, assistant curator at the Museum, is also interested in marine life, making a specialty of the marine annelids of the Atlantic coast.

Dr. I. W. Blackburn, of the Insane Asylum, has done superlative work in the histology of the nervous system. It is said that his sections of whole brains cannot be beaten. He is professor of general pathology and histology in Georgetown University, and with him are associated Dr. Robert T. Edes, who is an expert microscopist, Dr. John J. Stafford, and Dr. W. S. Bowen, both of whom use the tube.

Howard University has a goodly number of microscopists on its faculty list, among whom may be mentioned Dr. D. S. Lamb, who is curator of the Army and Medical Museum; Dr. J. Melvin Lamb, lecturer on microscopy and histology; Dr. Seaman; Dr. Thomas B. Hood, who, we are sorry to say, is on the sick-list (he has been trying Koch's lymph on some patients at the Garfield Hospital, and has not a word to say in its praise); Dr. Robert Reyburn, who is just now at work in micro-photography; and Dr. E. A. Balloch, a lover of microscopy, but now so engrossed in practice that his microscopic work is mainly confined to examinations necessitated by daily routine. This is apt to be the case with the busy practitioner everywhere. The cares of this world and the deceitfulness of poverty choke out pure science.

The National Medical College has among its faculty Dr. Gray, Dr. Shute, and Dr. Acker, the histologist.

At Kendall Green, too, Prof. Chickering, the genial and enthusiastic botanist, has a fine microscope, and uses it.

Prof. Edward S. Burgess, of the High School, well-known botanist, gives attention to the fresh-water algæ of the District of Columbia. At work in the various departmental buildings are many men who spend their evenings at the binocular. The unpretentiousness of some of these workers is delightful. They are not microscopists. Oh, no. They use the instrument simply for amusement. But after a little friendly visiting, they will show you some method, device, or specimen that will excite your emulation to the highest degree.

Thus Mr. H. H. Doubleday, from a book-case piled with works on patent law, took a tin-and-glass device for showing the circulation in a gold-fish's tail. It is an improvement on Kent's fish-trough, and consists of a tank soldered to the top of the trough, large enough to hold water to last the fish an hour or so. The fish is held in place by a perforated tin cover weighted down by a bottle of shot. He also has a Queen's revolving table fitted up with electric lights. Away out on Florida avenue we found Dr. Alleger, with a good microscope, shaving sections of brain and medulla. Woe be to the cats and rabbits in that quarter.

Then there is Mr. J. M. Yznaga, who rests from his law books by peering down the tube, and takes an active interest in our Society. J. M. Stedman can tell you about the fresh-water sponges. Dr. C. H. Stowell is well known as the author of Histology of the teeth. Dr. J. F. Scott studies pathology. Drs. Radcliffe, Robbins, Richardson, and Gibbs all had specimens on exhibition at our last soiree. Also Mr. A. N. Skinner, of the Astronomical Observatory. Mr. Lewis Mooers works in urinalysis and bacteriology. Dr. Collins Marshall studies the diatoms, and Mr. John Grinstead the protozoa.

Prof. Richard Foster, of Howard University, has biology for his province. Dr. H. A. Dobson studies pond life. Dr. Cooper Curtice is an expert on the subject of animal parasites.

Dr. C. T. Caldwell is another of those who still keep up an interest in microscopy, though cumbered with a busy practice. He was one of the charter members of the Society, and for several years Lecturer on Histology and Urinalysis at the National University.

But we pause, not for lack of material, but for lack of time to pursue our investigations further. We wish simply to show that the Capital is alive on the subject of microscopy, and we guarantee that the members of the National Association will meet a warm welcome here.

BACTERIOLOGY.

The Microbe of Malaria.—Dr. F. Plehn, in the *Zeitschrift fur Hygiene*, gives an account of some researches of his in this subject, and a history of the opinions entertained by others during the last twelve years. In 1879 Klebs and Tommasi-Crudeli described a bacillus found by them in the water and soil of the Roman campagna, which they were led by certain experiments to look on as the microbe concerned in the causation of malarial fevers. In 1880 Laveran found in the blood of a subject of malaria in Algiers an organism not present in that of healthy persons, which he called *plasmodium*, and maintained to be the essential agent of the disease, in opposition to Klebs and Tommasi-Crudeli. Zeihls in 1882, and von Schlens in 1884, discovered bacilli and cocci in the blood of malarial persons in Italy, but made no experiments. Previously to 1880 Koch's method of pure culture was unknown, and though Klebs and Tommasi-Crudeli had never found the bacilli in the blood of patients, the transfusions of Dochmann, Gerhardt, Cuboni Golgi, and Marchiafava were considered to be conclusive. But the Nestor of bacteriologists, Fred. Cohn, has since deprived the bacil-

lus of all claims to a pathogenic character, Klebs himself has at last disowned his fondling, and Marchiafava and others have gone over to the other side.

Laveran's conclusions have been supported and vindicated by the observations and experiments of Marchiafava, Celli, and Colgi in Italy, Metschnikof, Czenzinski, and Sachrof in Russia, Sternberg, Councilman, and Osler in America, and of Laveran himself in Corsica, Tonkin, Madagascar, and Senegal, whose combined experience has established its claims almost beyond question, though Dujardin, Pfeiffer, Rosenstein, and Hoffmann have alleged that *plasmodium* is present in the blood in other febrile conditions, as typhoid, scarlatina, and vaccinia, and that it is therefore to be looked on rather as a modification of some of the normal elements.

Fischer, of Kiel, examined the blood of eighty subjects of malaria from the Cameroons, West Indies, etc., and Schellong that of a large number of patients in New Guinea, and, since his return to Germany, of cases of recurrent attacks, with none but negative results. It must, however, be borne in mind that the value of negative evidence is at a minimum when the object of the search is new, and only to be detected by special methods of examination and staining, demanding much technical skill and practice.

Dr. Plehn, after nine months' preparation as assistant in the Hygienic Institute at the University of Jena, began his observations at the Moabit Hospital in Berlin on three cases of typical intermittent fever in which the several stages were well marked, the temperature reaching a maximum of 41° C. (105.8° F.), and respectively of the quartan, tertian, and quotidian forms—the last, however, subsequently passing into the tertian. The two former, from Hamburg and Posen, gave negative results, but he was successful in the case of the last, a laborer from Potsdam, who had suffered for two months from severe quotidian ague, for which he had had no medical treatment, having been refused admission to the hospital there from want of room. It is worthy of notice that after this man had been treated with large doses of quinine, and the quotidian had been succeeded by the tertian form, the plasmodia rapidly decreased in numbers and soon disappeared entirely. This may account for the failure of many observers, to say nothing of the paucity of material at the disposal of most compared with the opportunities enjoyed by Italian physicians, among whom Celli and Guarnieri, for instance, have treated as many as 2,000 patients in one summer.

In the Potsdam case Plehn found the plasmodia in abundance in all stages of the disease, but especially during the febrile exacerbations. Only the smaller were colorless, the larger being pigmented by granules and rods of melanin irregularly disposed. For the details of his manipulations we must refer to his paper. In a postscript he states that since going to press he has also found the plasmodia in great numbers in the blood of a recurrent case returned from Sumatra, and that he intended continuing his observations on every opportunity.

Detection of the Bacillus Tuberculosis.—Prof. John Guiteras gives, in a lecture printed in the *American Lancet*, the following directions for detecting the bacillus tuberculosis: "The bacillus is not easily stained by anilin dyes, which stain other micro-organisms so easily. To stain, the anilin must be mixed with an alkali. After taking

the stain, the bacilli part with it with difficulty. Anilin oil and carbolic acid render the same stainable. The most certain and satisfactory stain is fuchsin and carbolic acid prepared as follows: One part of fuchsin is dissolved in a 5 per cent. aqueous solution of carbolic acid; to this add 10 parts of absolute alcohol. This is suitable both for cover-glass preparations of sputum and for sections of the tissue to be examined. This stains the tubercle bacilli and other substances all red. Stain again in Gabbett's solution, methyl blue dissolved in sulphuric acid. Dissolve 1 or 2 grains of methyl blue in a 25 per cent. aqueous solution of sulphuric acid. If it is a cover-glass preparation, swim it on the solution. If the solution is warm, it will take the stain in three or four minutes. If it is a section of tissue, keep it in the solution fifteen minutes. If the solution is not warm, leave it in twelve hours. From this solution wash in water. If a section of tissue, pick it up on a glass slide, dry with bibulous paper; when it is dry, drop on 1 or 2 drops of Gabbett's solution, and allow it to remain one-half to one minute, then wash off with a stream of 95 per cent. alcohol, poured upon the specimen; dry and clear with oil of cloves, and then mount upon slide, etc. Second method: Stain with methyl violet dissolved in anilin water. Take 5 parts of anilin oil to 100 parts of distilled water; shake thoroughly; filter through moist filter paper. This gives a clear solution. To a watch-glassful of this add 5 drops of gentian violet. After the tubercle bacilli is stained, the color is removed from the other structures by an acid. Immerse it for only a moment in the acid, then wash the acid out with water. Stain with a contrast color, as vesuvian or Bismark brown." Spores do not take the stain.—*The Druggists Circular and Chemical Gazette.*

EDITORIAL.

Micro-Organisms.—Through the courtesy of Prof. Floyd Davis, the author of Potable Water, and Messrs. Silver, Burdett & Co., of Boston, the publishers, we are permitted to reprint the chapter on Micro-Organisms, which appears in another column of this issue. This subject is specially interesting and instructive, and we desire to express our thanks here to these gentlemen for their kindness in allowing us to use this material in the *Journal.*

Personal.—Mr. Edward Bausch and family sailed for Europe, July 30, on the steamer "Normannie" to attend the meeting of microscopists at Antwerp, which is the Triennial Celebration of the Discovery of Microscopy. We take pleasure in wishing Mr. and Mrs. Bausch a happy journey, and trust that at an early date the readers of the *Journal* may be favored with an account of the meeting.

The Photo-American Review.—This magazine made its first appearance in May, 1891. It is well printed and delightfully illustrated. Its pictures are all taken from nature—much skill and wisdom being shown in their choice. Each number contains interesting and instructive papers on general photography. Another important feature is the list of new books, which not only contains a record arranged alphabetically with the author's names, but a short review of each work.

MICROSCOPICAL SOCIETIES.

San Francisco, Cal.—Wm. E. Loy, *Sec'y.*

June 1, 1891.—President Wickson in the chair. Despite the fact that many members were out of the city on vacation or business, a very good attendance was noted, and the proceedings proved of more than ordinary interest. Four new resident members were elected, viz: H. O. Perley, M. D.; B. Noyes, George O. Mitchell, and E. F. Glasher.

The President spoke of the efficient work performed by the Committee having in charge the removal of the Society's effects, and the arrangements for the anniversary meeting, so successfully held last month. A vote of thanks was unanimously tendered that Committee, and special mention was made of the services rendered by Mrs. Breckenfeld and Mrs. Loy in furnishing and decorating the rooms for the occasion.

C. W. Woodworth, of the Agricultural Experiment Station at Berkeley, was present and exhibited some slides, showing the scale insect infesting the leaves of the olive. He called attention to the fact that certain closely allied species of scale insects were invested with an outer covering produced by exuvia, or by hardening of the skin, while in the species under consideration this outer covering seemed almost entirely composed of the stellate hairs accumulated from the under side of the leaf of the olive on which it feeds. As the lava grows it insinuates itself beneath these stellate hairs, which become broken from the leaf and attached to the skin of the developing insect. Mr. Woodworth exhibited two slides, one the young larval skin, of about one-fourth the adult size, and the other the complete adult form.

Henry G. Hanks exhibited some curious so-called lava, recently obtained from Butte county. In November last Mr. Hanks read a paper before this Society on "Certain Magnetic Rocks," in which he assumed that the rocks at Tuscon were nearly identical with the Table Mountain capping, which overlies the deep gold placers of this State, protecting them from denudation and dispersion. During a recent visit to Butte county for the study of this formation, he made two important discoveries bearing on this subject, which at least afford strong evidence in favor of the opinion stated in the paper referred to, that the rocks were not of igneous, but of aqueous, origin.

The first discovery was at the mouth of Chico Cañon, where William Proud showed him some cylindrical natural tubes in the so-called lava, which Mr. Hanks believes to be solfataric steam-pipes. These varied from the size of a quill to three inches or more, and some of them are at least four feet deep. They are not rare, but common, and, it is believed, may be found elsewhere. The inference drawn from this discovery is that these rocks, supposed to be igneous, are really overflows of solfataric mud; otherwise it would be impossible to account for the steam-pipes, for the rock must have been at one time soft and permeable.

The second discovery was a fragment of the same rock obtained from Mrs. Caroline H. Church of the Aurora drift mine, near Magalia, in which there is the cast of a pine cone, so perfect that when liquid plaster of paris is poured in a model of the cone is obtained, showing every

detail of structure. Mr. Hanks had examined the cast closely with the microscope, and could find no trace of charcoal. Nor can it be possible that the rock was hot, for had the cone been burned the fine striations could not have been so perfectly preserved. It is Mr. Hank's intention to study these rocks microscopically, and report to the society the results of his further researches.

In view of the prominence given to the question of the discovery of the microscope, and the celebration of the three hundredth anniversary soon to take place in Antwerp, Mr. Riedy exhibited an old book by Petro Barello, published at The Hague in 1655, entitled "A History of the Telescope and the Microscope." This old book is remarkable as being the first published work treating of the discovery.

June 4, 1891.—After discussing the refreshments furnished and drinking the success of the society, the audience was called to order by President Wickson, who called attention to the fact that the society had reached its majority, having been founded June 4, 1870. He spoke briefly of its career, alluded to its vicissitudes and pointed with pride to its success. The Committee had prepared a list of sentiments which he would proceed to announce.

"The Birth of the Society" was responded to by Dr. S. M. Mouser, who had watched over its early development and growth, from the time it cast its swaddling clothes until its present vigorous maturity.

"Our Coming of Age" was very happily treated by Colonel C. Mason Kinne, who was one of the original six who met together exactly twenty-one years before and laid the foundations. He regretted that he alone of that number was present on this occasion. The early members were poor but ambitious, and one object of those who originated the society was the purchase of a first-class microscope and accessories, something the individuals could not afford.

"The Microscope in Medicine" was responded to by one of the veterans—Dr. J. H. Wythe. He alluded to the fact that his first microscope was purchased fifty-five years ago, and that as a result of his earlier investigations with the instrument, he had prepared a paper on Bright's disease, which he read before a county medical society to which he belonged in Central Pennsylvania. Some of the old physicians who listened to it said they had always diagnosed diseases without a microscope, and could see nothing to be gained by calling in its aid, at the same time advising the young medico to "go slow."

Dr. M. C. O'Toole responded to the sentiment of "Brass and Glass" in a very witty little speech, which was received with every mark of appreciation.

The President next announced "The Microscope in Relation to the Point in Dispute," which was responded to by ex-Judge Rearden. He alluded to Cicero's words, where he speaks of the kinship existing between all professions, and how science has ever had the respect of the legal fraternity. In courts of justice scientific experts always command the respect of bench, bar, and jury. In view of the wonderful discoveries made by scientists, especially the discoveries of the past twenty years, showing the intimate relations of micro-organisms and disease, the Judge ventured to remark that coming generations might demonstrate that all human impulses were controlled by the presence or absence of certain forms of bacilli. The ardent swain of the twentieth

century may hear from the lips of his charmer that her organism is deficient in the bacillus of love, and consequently she cannot return his affection.

Dr. G. M. Sternberg, U. S. A., spoke entertainingly to the toast, "Our Honorary Members," and "Kindred Societies" was responded to by E. M. Ehrhorn, President of the California State Entomological Society. A. H. Breckenfeld responded for "Our Absent Friends," and Professor Searby spoke to the sentiment of "Auld Lang Syne," with his tribute to the society and its work. His remarks were well received. The programme was further enlivened by some choice vocal selections given by Alfred Wilkie.

Those present were: E. J. Wickson, C. Mason Kinne, William E. Loy, Dr. S. M. Mouser, William Norris, A. H. Breckenfeld, Charles C. Riedy, E. W. Runyon, Henry Kahn, B. Noyes, E. F. Glasher, P. S. Barbour, Dr. George K. Frink, R. H. Freund, Dr. I. Rivas, Dr. M. C. O'Toole, Hon. T. H. Rearden, W. F. Myers, T. C. Coxhead, Alex. Craw, E. M. Ehrhorn, E. L. Hawley, Dr. Nathan Rogers, Dr. E. S. Clark, Dr. C. H. Eigenmann, Dr. J. M. Selfridge, Dr. G. W. Davis, Charles Ulrich, J. J. B. Argenti, John H. Gray, T. A. Rottanzi, B. M. Lelong, M. W. Ward, Emmet Rixford, Dr. Kaspar Pischl, Leo Newmark, S. E. Taylor, T. C. Pinckney, Dr. J. H. Wythe, Dr. George M. Sternberg, George T. Folsom, W. M. Searby, David W. Loring, L. M. King, S. P. Smiley, Alfred Wilkie, George W. Colby, H. K. Goddard, A. S. Brackett, J. G. Clark, A. H. Smith, Dr. Douglas A. Montgomery, and William Payzant.

June 17, 1891.—Vice-President Selfridge in the chair. After the reading of the minutes four applications for membership were received and other routine business was transacted.

The secretary announced the receipt of the usual periodicals for the Society's reading-table, and a copy of Johnston's British Zoophytes by donation.

The cabinet was enriched by a quantity of diatomaceous earth, very rich in fossil diatoms, found near Lompoc, Santa Barbara county, presented by Henry G. Hanks. Henry C. Hyde presented a caterpillar from New Zealand, with a curious fungus grown from the head. The caterpillar is known by the common name of the "bulrush caterpillar," and to science as *Sphœria Robertsia*. The natives, however, call it "aweto." The plant, or fungus, in every case fills the body of the caterpillar, which in well-grown specimens reaches a length of three and a half inches. The fungus rises from the head and attains a length of six to ten inches. When found, the body of the caterpillar is buried beneath the surface of the soil or leaf-mold, and the greater portion of the stalk as well. The apex of the plant, when in fructification, resembles the club-headed bulrush. There is every probability that the seeds or spores of the plant find a lodgment in the folds of the caterpillar's skin, where the temperature and moisture soon cause them to germinate, and the growth soon causes the death of the animal, its tissues supplying food for the plant.

William Norris presented to the Society two photographs of diatoms, made by B. W. Thomas, of Chicago, one a species of *Eunotia* from Ellensburgh, Washington, and the other a species of *Asterolampra* from Fisherman's Cove, California. This latter, Mr. Thomas writes,

seems to be a new species, as it does not conform to the known species of that genus.

The paper of the evening was read by Harold Sidebotham, M. R. C. S., L. R. C. P., late of London, on the subject of "Cell Division." He alluded to the various theories held at different times by biologists on this subject, illustrating the same by drawings on the blackboard. The later and more generally accepted theories were also fully exemplified, to the evident gratification of his hearers. A series of carefully stained preparations showed the various stages of the animal cell, and it was remarked that his staining of the extremely delicate tissues of the infusorian, *Paramecium*, were worthy of more than passing notice.

Discussions on the paper followed, entered into by Dr. Sternberg, Dr. O'Toole, and Colonel Kinne. Dr. Sternberg spoke at some length of the process of cell division as witnessed in the study of bacteria cultures, which is essentially the same as in the animal cell.

Dr. Gray read a paper on the anatomy of the insect tracheæ, largely made up of references to the early literature of the subject.

NOTICES OF BOOKS.

Socialism. By John Stuart Mill. The Humboldt Publishing Co., 19 Astor Place, New York.

The publication of a special volume showing John Stuart Mill's attitude upon the question of Socialism should be a matter of congratulation, both to Individualists and Socialists. By his position in society, which was one of easy independence, rendered healthy by very moderate official toil, he was most fortunately placed for the literary work to which he devoted his life; his writings mark exactly the beginning of the transition period from the *laissez faire* theories that had so long dominated English thought, and by the natural repose of his character he was singularly fitted to fill the office which he regarded as the crying necessity of the hour, viz., that of "an unprejudiced legislator, absolutely impartial between the possessors of property and the non-possessors."

John Stuart Mill was more than a mere student of the closet. Throughout his life he mixed on terms of the closest intimacy with the most distinguished men of his day, and he himself served in parliament. As a student he followed closely the speculative thought of Europe, though his ignorance of German, at a time when there were few translations, handicapped him heavily. As a man of action he took part in all the progressive movements of the time; battled bravely for women suffrage; insisted strenuously on the right of the poorest to a voice in the councils of the nation, since their very existence was jeopardized by misgovernment; and anticipated the whole Irish and general agrarian movement by the keenness of his criticism on the sins of landlords. All these subjects are treated, with a peculiar lucidity that John Stuart Mill had invariably at command, in this second volume of the *Social Science Library*. They make 214 pages of excellent reading matter, and should be read by all interested in Socialism.

Flora and Fauna within Thirty Miles of Hanover, N. H. By Henry G. Jesup, A. M., Professor of Natural History, Dartmouth College.

This is one of the most carefully compiled plant catalogues ever issued. Since Prof. Jesup published his provisional catalogue in 1882, he has been constantly at work on the local flora of his section. The result is this pamphlet, remarkable for the absence of errors. The nomenclature is that of Gray's Manual, 6th ed., and Jordan's Vertebrates, 5th ed.—*F. B.*

SUBSCRIBERS' NOTICES.

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The Fourteenth Annual Meeting of the American Society of Microscopists.

BY ROBERT W. SMILEY,

WASHINGTON, D. C.

The extensive series of national scientific conventions that will last well into September, was begun on Tuesday, August 11, when the American Society of Microscopists assembled for the fourteenth annual meeting in the lecture room of the Medical Department of Columbian University, Washington, D. C. The main room on the ground floor of the building was used for the meetings of the microscopists. The arrangements for the convention were in the hands of the Microscopical Society of this city, and all the preliminary work of arranging for a successful convention was well done.

The morning sessions of the Society were given up to business and reading of papers, while the afternoons were devoted to visiting the various scientific bureaus of the Government, in nearly all of which the microscope is extensively used.

The headquarters of the Society were at the Hotel Arno.

TUESDAY MORNING.

Dr. F. L. James, of St. Louis, President of the American Society of Microscopists, called the members to order at a few minutes past 10 o'clock. The opening prayer was then offered by Rev. R. S. L. Wood.

Dr. J. S. Billings, of the Army Medical Staff, welcomed the visitors to Washington. His remarks were principally devoted to an account of the growth of the interest in the microscope in the Government departments. Among other things Dr. Billings said:

THE PRESIDENT, LADIES, AND GENTLEMEN: It is my pleasant duty this morning to bid you welcome to Washington and to say to you that

you are to make yourselves very much at home here. Washington, as the capital of the country, is, in fact, the natural and proper home of all national associations, and they are beginning to discover this, for the number of such gatherings here increases every year. Within the last twenty years this city has become not only one of the most beautiful cities in the world, but has become one of the great scientific and literary centres of this country. The needs of different departments of the Government for accurate and precise information upon many subjects connected with their work have brought together here in the different bureaus many men specially trained in modern methods of investigation and research, each working in some particular line, and more or less of an expert upon some one particular subject, yet also interested in the general progress of knowledge and the results obtained by his fellow-workers. Hence it is that our local scientific societies are numerous, well attended, and have an abundant supply of material to interest their members, more so, probably, than the majority of local societies in other and larger cities. Among these associations we number an active and flourishing microscopical society, for although the Government has no department or bureau exclusively devoted to this subject, yet in almost every department and in many of the bureaus there are and must be men who are familiar with the use of the microscope or they could not answer the questions which are liable to come before them at any moment. You may be sure, therefore, that the American Microscopical Society will always find an appreciative and interested audience for its papers and discussions here. Of the numerous bureaus of the Government which make use of and are interested in the microscope and microscopic technique, there is none which makes more constant use of this method of investigation, and none which in times past has done more to stimulate improvements in microscopy, than the medical department of the army, including the Army Medical Museum. The improvements in microscopic objectives which have been made during the last thirty years have been, to a considerable extent, stimulated, suggested, and given definite direction by the application of photo-micrography to the testing of such objectives as to resolving power and flatness of field under different conditions of illumination.

Photo-micrography, with high powers, became a practicable and useful process when the use of direct sunlight as a means of illumination was introduced. This was first done in this country by Prof. O. N. Rood, of Columbia College, N. Y., in 1860–'61. It was first suggested and applied in this country to histological preparations in the spring of 1864 in a military hospital here, in Washington, by two assistant surgeons in the army, Jas. William Thomas and William R. Norris, both now well-known ophthalmologists in Philadelphia. These gentlemen brought the results obtained by them to the attention of Dr. J. J. Woodward, of the army, who was engaged in the collection of materials for the preparation of the medical history of the war and the formation of an army medical museum, and by his direction the process was taken up, extended, and improved by Dr. Edward Curtis, now of New York, who was then engaged in making microscopic preparations to illustrate the pathological histology of certain camp diseases. Subsequently Dr. Woodward himself took the matter up, studying especially the optical combinations and technique of illumination adapted

to secure the best results, and applying these methods as a means of minutely and accurately comparing the powers and performances of different objectives, and of making of such performances records whose accuracy could not be questioned and which could readily be compared with each other.

When Dr. Woodward was doing the greater part of his testing work homogeneous immersion objectives were unknown, and with high powers the proper adjustment of the cover correction was a matter of the greatest importance to secure the best results, and was also often a matter of very considerable difficulty. Dr. Woodward's skill and patience in making these adjustments and in the regulation of the illumination were unrivalled. He often spent half an hour and more in securing a single cover correction, and the makers of microscopic objectives, both in this country and abroad, came to recognize the fact that he was not only absolutely impartial in his tests, but would get from each lens the very best work of which it was capable. The result was that they were glad to send him lenses for trial and to obtain his suggestions as to the possible means of improvement, which in this way was strongly stimulated. Since his death microscopic and photo-micrographic work have been carried on steadily in the Museum, but on somewhat different lines, consisting mainly in the practical application of these methods to pathological research and to bacteriology. We shall be very glad to have you spend as much time at the Museum as you can spare and to show you what we are doing there. In this connection I wish to invite your attention to two cases at the south end of the main Museum hall which contain a number of microscopes illustrating the development of and changes in this instrument and its accessories from the time of the first-known compound microscope of Janneus in 1685 down to the present time. In bringing together this collection during the last ten years I have been greatly aided by Mr. John Mayall, of London, who has had so much to do with the formation of the magnificent collection of Mr. Crisp. Permit me to remind you that, as citizens and sovereigns of the Republic, the Medical Museum belongs to you, and that as American microscopists its collection of microscopes and of microscopic slides and material should be a matter for your special interest and care. The collection is very far from being complete—it is only the beginning of what I hope will one day be gathered and carefully preserved in it, namely, a specimen of every different form of microscope, and especially of the earlier forms of American makers, of which we have none, and also specimens of the best work of American microscopists which can be shown by permanent preparations; and to secure this I ask your assistance. The library of the Surgeon-General's Office, connected with the Museum, is rich in books and journals relating to the microscope and its uses, especially in its applications to biology and the medical sciences, and is available to all who wish to use it. If you are not familiar with its resources and its index I hope you will become so while you are here.

I speak first and chiefly of the Army Medical Museum and Library simply because it is the division of the Government with which I happen to be most familiar, but you will find microscopical work going on in the Department of Agriculture, in the National Museum, and elsewhere, and in all these places you will be welcome visitors.

Addresses of welcome are, I think, usually satisfactory in the inverse proportion of their length, hence I will take up no more of your time, and close, as I begun, by assuring you that we are all very glad to see you here, and hope that you will make yourself entirely at home with us.

Dr. Thomas Taylor, president of the Washington Microscopical Society, next made a short address of welcome, in which he told of the growth of his own interest in the microscope, and what he had accomplished with the instrument. He also reviewed the interest being taken in microscopic work by the Government, which was the first Government to take any active steps in microscopical work. He described the use and growth of the local society, and bade the members of the American society a hearty welcome in the name of the society of which he had the honor to be president.

Dr. James made a brief reply, expressing the gratitude of the visiting society for the hearty reception tendered.

The report of the secretary was then read by Dr. W. H. Seaman. He announced that the membership had reached 400, and that upward of fifty new names would probably be added to the society's membership as soon as the executive committee had a chance to meet and pass upon them. He recommended that Wednesday evening be given up to a meeting for the consideration of routine business.

The reports of the committees on medico-legal microscopy, on the Columbian Exposition, and also of the committee on the revision of the constitution, were passed over to be presented at a future date.

The question of incorporation was the next item of business on the programme. Dr. Seaman and Dr. Reyburn spoke in favor of incorporating the society, the latter accenting the advantages that would ensue from going through with the legal forms in the District, where the incorporation of all national societies should be made. Ex-President Lewis also favored the proposition, and, on motion of Mr. C. C. Mellor, it was decided that the president should appoint a committee of three to take entire charge of the matter. Dr. James appointed as this committee Dr. Robert Reyburn, Mr. J. M. Yznaga, and Dr. Wm. J. Lewis.

Tuesday Afternoon.

In the afternoon the microscopists went in a body to the United States Geological Survey. A thorough examination of the work of this department was made.

Tuesday Evening.

The evening session was very brief, and consisted only in the reading of the presidential address by Dr. F. L. James on "The Microsope in the Investigation of Scorches and Burns on Textile Fabrics." Dr. James started out with an interesting story of his own experience, in which the microscope, in an indirect manner, finally proved to be the agent in saving a human life, and establishing the innocence of one unjustly accused of being the murderer of his young wife. (This paper will be published in full in the *Journal* for October).

Wednesday Morning.

There were between fifty and sixty persons present at the morning session.

The first business on the regular programme was the election of new members. Secretary Seaman read the list that had been acted upon favorably at the meeting of the Executive Committee. The new members elected were as follows:

Dr. Charles D. Smith, Portland, Me.; Prof. E. G. Love, New York; Prof. Edward A. Burt, Albany, N. Y.; Dr. R. P. Crandall, U. S. N., Brooklyn; Dr. Henry N. Heinemann, New York; Nathan Banks, Sea Cliff, N. Y.; Dr. Julius A. Gottleib, New York; Dr. James M. Flint, Washington, D. C.; Dr. Otto Platt, Cincinnati; Rev. George E. Goetz, Erie, Pa.; Dr. J. Melvin Lamb, Washington, D. C.; Prof. Arthur H. Elliott, New York; Dr. James Foster Scott, Washington, D. C.; J. C. Brubaker, Kansas City; Dr. Charles B. Gilbert, Washington, D. C.; F. Patrick, Topeka, Kans.; Dr. H. W. Ingalls, Lagrange, Ohio; Dr. S. H. Platt, Waterbury, Conn.; John Michels, Chicago; Dr. A. E. MacKay, Portland, Oreg.; Jonathan White, Brockton, Mass.; Dr. A. L. Kotz, Easton, Pa.; Dr. Robert S. Willard, Brownsboro', Tenn.; Dr. Ernst Wende, Buffalo; Dr. Joseph P. Remington, Philadelphia; W. H. Ohler, Portland, Me.; S. W. Callett, Glidden, Iowa; Dr. Thomas B. Hood, Washington, D. C.; Dr. James Barnesfather, Cincinnati; Rudolph Siemon, Fort Wayne, Ind.; Dr. J. W. Meeker, Nyack-on-Hudson; Dr. W. S. Miller, Worcester, Mass.; Dr. James Stimson, Watsonville, Cal.; Thomas D. Biscoe, Marietta, Ohio; Dr. Paul Paquin, Columbia, Mo.; Dr. W. T. Baird, Dallas, Tex.; Robert O. Moody, New Haven, Conn.; Harry F. Startsman, Rochester, N. Y.; N. Howland Brown, Philadelphia; Charles H. Denison, Brooklyn; Gustave Guttenburg, Pittsburg; Magnus Pflaum, Pittsburg; John B. Smith, New Brunswick, N. J.; Herbert Eastman Kerrey, Littleton, N. H.; Dr. H. L. E. Johnson, Washington, D. C.

Dr. Robert Reyburn, of the committee on incorporating the society, read a report, showing what had been done and what yet remained to be done in the formality of the proceedings. In reading the form of incorporation, he suggested that the name of the society be changed from the American Society of Microscopists to the American Microscopical Society. This suggestion met with general favor on account of the bulk and awkwardness of the old name. It was moved that the change be made, and the motion was carried.

Dr. L. D. McIntosh, of Chicago, then read an interesting paper on "The Portable Lime Light," illustrating his remarks by means of an instrument, using the light, with which he presented a slide upon a screen about twelve feet distant. He explained the workings of the machine.

Dr. J. Melvin Lamb next read a paper on "The Microscope in Government work." This was somewhat in the nature of a guide to the society, giving the members a very good idea of the work that is being done with the microscope in the departments here, and telling them where they could see the most that would be of interest to microscopists.

Mr. Bausch, of Bausch & Lomb Optical Co., read a brief description of a new microscope recently placed on the market.

Dr. James M. Flint, of Washington, presented an interesting and entertaining paper on "Apparatus for public and class exhibitions of microscopic objects." He explained a number of ingenious devices for

lightening the work of the operator when giving an exhibition of a series of objects. The inventions of Dr. Flint attracted the close attention of the scientists, and his work in this direction was highly complimented. In the discussion which followed, Dr. Thomas Taylor described a simple rotary slide-carrier that he had devised for exhibiting a number of objects.

After the reading of some announcements by the secretary the meeting adjourned.

Wednesday Afternoon.

In the afternoon the microscopists visited the Department of Agriculture. Work is in operation here of such vast importance that it has attracted the attention of scientific men all over the world. The study of animal germs is being investigated, and the very highest class of work is done on the same principles as those under which Koch and Pasteur are pursuing their researches in Europe. The result sought to be accomplished is the discovery of the cause of pleuro-pneumonia and Texas fever in cattle. A steer was recently inoculated by the scientists of the Department, and Texas fever produced. The men in this part of the investigation think they have discovered the germ of this disease.

Vegetable pathology is also undergoing a thorough investigation, with a view of applying the proper remedies for peach yellows, rust, blights, and the hundreds of other diseases that attack and destroy fruit, grain, and vegetables. All this is being done through the agency of the microscope, and it opens up a wide field for the investigator. The Department now has an agent in Florida investigating orange blight, another in California looking into the causes of the grape disease, another in New York applying remedies to the blights and scabs in fruit. They have expert men in all parts of the country studying these diseases with the aid of powerful glasses, and seeking to provide the information that will stop the encroachment of these animal diseases.

The Agricultural Department also has a microscopic division proper that is making a specialty of the fibres—wool, flax, hair, hemp, wood, cotton, etc. So great has been the work of this department that Dr. Taylor, its chief, is in constant demand in the United States courts to decide the character of fibres constituting goods, detecting the difference between the wool of sheep and the hair of goats, etc. This department has made wonderful strides, and all its workings proved a source of useful information for the members of the Microscopical Society, who spent the whole afternoon at the Department.

Wednesday Evening.

A special business meeting was held in the evening. The question of the new constitution was referred to the executive committee with power to act after the certificate of incorporation had been filed.

A committee was appointed to nominate officers, and also to nominate a director of the working session of the microscopists at the World's Fair. The following committee was appointed: D. S. Kellicott, S. H. Gage, Robert Reyburn, W. J. Lewis, George E. Fell, J. M. Lamb, and L. D. McIntosh.

It was decided to print 750 copies of the proceedings of the associa-

tion. The proposition to distribute the volumes on hand to different libraries was referred to a committee. The committee on publication was instructed to consider and report at a future meeting upon the advisability of publishing an organ of the Society.

Dr. L. D. McIntosh having in charge the proposed exhibit at the World's Fair, submitted a report of progress, in which he detailed what the Commissioners would do for the scientists. Dr. McIntosh's committee was continued. After discussion, Profs. Claypole, Gage, and Burrill were appointed a committee to consider the feasibility of inducing American manufacturers to make their microscopes of the same standard, so that the users of these instruments would not be troubled as they are now with parts that are not interchangeable.

Thursday Morning.

Secretary Seaman announced that the executive committee had taken favorable action upon the following names, in addition to those read yesterday: Dr. Henry A. Robbins, Washington, D. C.; Frank Zentmayer, Philadelphia; Dr. George N. Acker, Washington, D. C.; Frank Patrick, Topeka, Kansas; Geo. Swainson, Nevada, Missouri. These were unanimously elected members of the Society.

The first paper read at the session this morning was the joint production of Prof. Simon H. and Susannah P. Gage, on "Comparison of the Epithelium of the Mouth in Necturus and Diemyctelus." It was read by Mrs. Gage, who showed herself thoroughly conversant with all the phases of her subject, and at the conclusion of her paper she was called upon to answer a number of questions with reference to certain points upon which she had dwelt in her essay. Prof. Gage, who began by saying that while it was stated that the paper was a collaboration he really had not known what was in it until he had heard it read, added some interesting comments upon the paper.

Prof. Wm. H. Seaman, the Secretary of the Society, read a lengthy treatise on "The Phosphorescent Organs of Fireflies."

Dr. Deck explained a simple form of heliostat, which he had invented as a result of his own needs in photo-microscopy. It was arranged on the principle of the equatorial telescope.

"A Brief Account of the Microscopical Anatomy of a Case of Chrome Lead Poisoning" was the subject of an essay by A. Miss Vida Latham. She told of the death of a woman from lead poisoning. The woman was the wife of a plumber and brass founder. She frequently assisted about the shop, and lived in an adjoining room, so that she came under the influence of the dread poisoning. Miss Latham gave a graphic account of the illness and death of the patient and of the microscopical examination that was made subsequent to an incomplete autopsy.

After a recess of five minutes the nominating committee reported the following nominations for the ensuing year: President, Marshall D. Ewell, of Chicago; vice-presidents, Dr. Robert Reyburn, Washington, D. C., and R. J. Nunn, Savannah, Ga.; members of the executive committee: Dr. J. A. Miller, Buffalo; E. W. Claypole, Akron, Ohio, and Dr. J. M. Lamb, Washington, D. C. The secretary, Mr. W. H. Seaman, and the treasurer, Mr. C. C. Mellor, hold over in office until 1893.

A second recess was taken in order that the Washington members of

the society might sign the articles of incorporation, papers being taken out under the District of Columbia laws, and a notary public being on hand for the purpose.

The society adjourned a little after noon.

Thursday Afternoon.

In the afternoon the society visited the office of the Surgeon-General, the Army Museum, and the National Museum, and spent the afternoon in studying the mounted objects that abound in these institutions.

Thursday Evening—The Soirée.

The notable feature of the meeting was the microscopic exhibit given for the benefit of the general public. At 8 o'clock the microscopical soirée was in successful progress. The illuminated building presented a fine appearance from without. Inside it was filled with light and life. The public had been invited and it accepted the invitation, and not one of the many present went away feeling that he had spent an evening in vain. The wonders revealed by the microscope were spread before the visitors, and the scientific man could look and linger as long as he pleased over the work of his scientific brother. It was a popular evening, and an entertainment as full of instruction as it was interesting.

Most of the objects chosen for exhibition were those which would best serve to engage and please the average visitor's attention rather than those of the most particular scientific interest. Among them were exquisite crystals of precious stones and metals, alloys, disease growths, animal tissues, forms of vegetable and shell life, hair, the parasites of various creatures, anatomical and physiological specimens, bacteria, trichinæ, micro-photographs.

In a darkened room another exhibitor was throwing the magnified objects upon a screen, after the fashion of a stereopticon. There were crowds of people about all these exhibits, and the exhibitors appeared to take as much pleasure in explaining all about them as the spectators did in viewing them. The soirée was a thorough success.

A few of the more important exhibits were as follows:

By Dr. G. N. Acker, with Zeiss: Cross-section of Human Hair.

By Dr. W. W. Alleger, with McIntosh: Flea.

By Dr. E. A. Balloch, with Zentmayer: Stomach of Turtle.

By Mr. A. F. Bartges, with Zentmayer: Section of Small Intestine.

By Bausch & Lomb, with B. & L.: Butterfly's Scales, Insect's Scales, arranged Diatoms, Foraminifera, Cornea of Eye of Shrimp, and Rolling Stones (Polariscope).

By Miss M. A. Booth, with Griffith Club: Hairs of Carpet Beetle, Flea of Cat.

By Dr. C. T. Caldwell, with B. & L.: Micro-Photographs.

By Mr. F. T. Chapman, with B. & L.: Electric Sparks.

By Prof. E. W. Claypole, with B. & L.: Trichina Spiralis in the Earth Worm; Fungi Growths on the Onion.

By Mr. Lyman Deck, with B. & L.: Foraminifera.

By Dr. Chas. H. Dennison, with Schreiber: Eggs of Moth; Crystals of Gold.

By Dr. H. A. Dobson, with B. & L.: Scales of Brazilian Beetle.

By Mr. H. H. Doubleday, with Crouch and Beck: Tongue of Blow Fly; Transverse Section Lily Bud.

By Dr. Geo. E. Fell, with McIntosh: Stomach of Cricket.

By Dr. J. M. Flint, with B. & L.: Foraminifera.

By Prof. Simon H. Gage: The Micro-spectroscope and the Spectrum of Arterial and Venous Blood.

By Mr. Joel G. Garretson, with Zentmayer: Photograph of the Moon.

By Dr. E. A. Gibbs, with Beck: Polycystina.

By Mr. John Grinstead, with B. & L.: Pond Life.

By Rev. Edward Huber, with Zentmayer and Zeiss: Parasites of the House Fly; Worms in the Head of the House Fly.

By Dr. F. L. James, with B. & L.: Crystals of Salicine (Polariscope).

By Prof. D. S. Kellicott, with McIntosh: Infusoria.

By Mr. F. W. Kuhne, with Zentmayer: Marine Algæ.

By Dr. J. Melvin Lamb, with B. & L.: Double Stained Blood Corpuscles Amphiuma.

By Miss V. A. Latham, with Beck: Skin of Finger in Leprosy.

By Dr. W. J. Lewis, with B. & L.: Spores of Ferns.

By Dr. L. D. McIntosh: Projection of Photo-micrographs; Injected Tooth Section; Injected Bone Section.

By Mr. C. C. Mellor, with McIntosh: Vase of Butterfly Scales.

By Mr. R. O. Moody, with B. & L.: Capillary Circulation in Intestine of Rabbit.

By Mr. Lewis Mooers, with Seibert: Circulation of Blood in Gills of Newt; Cilia on Gills of Fresh-water Clams.

By Dr. V. A. Moore, with Zeiss: Typhoid Fever Bacilli showing flagelli.

By Dr. R. Mumm, with B. & L.: Lung of Iron Worker.

By Dr. Robert Reyburn, with Queen: Bouquet of Flowers of Butterfly Scales.

By Prof. W. A. Rogers, with Latham: Development of Teeth, Serial Section

By Dr. W. H. Seaman, with B. & L.: Light-giving Apparatus of Fire-Flies.

By E. S. Seibert, with Zentmayer: Rock Section (Polariscope).

By Mr. C. W. Smiley, with Crouch: Potassium Chlorate (Polariscope).

By Dr. J. M. Stedman, with B. & L.: Eye of Embryo Cat.

By Dr. Thomas Taylor: Six Microscopes with new Turn-table and miscellaneous slides.

By Mr. S. Wagenhals, with B. & L.: Leech.

By Mr. W. H. Walmsley: Photo-micrographic Cameras, Apparatus, and Pictures.

By Williams, Brown & Earle, with Beck: Bacillus Tuberculosis, Interstitial Nephrites, Striated Muscle of Frog (Polariscope), Section of Nose of Mouse.

By Mr. Joseph Zentmayer, with Zentmayer: Diatoms, Blackberry Stalk (Polariscope), Gold.

Friday Morning.

A number of business propositions were considered. A resolution was adopted calling on Congress to remove or reduce the duties now levied on foreign microscopical apparatus, as altogether higher than necessary for the protection of the American makers.

The treasurer's report was read, showing $276 on hand at the opening of the meeting.

The election of officers followed, and the names proposed by the nominating committee were unanimously elected.

The question of the new constitution and change of name was then discussed. It was decided that in the future the society should be known as the American Microscopical Society, instead of the American Society of Microscopists. Considerable discussion followed as to the steps necessary to carry out the transfer of property and membership from the old to the new society. The details having been satisfactorily arranged, the reading of papers was continued.

Dr. J. M. Stedman read two very interesting papers, the first on "Killing of Invertebrata in an expanded condition," and the second "On the nervous system of a fresh-water sponge."

The following papers were presented to the committee, but owing to the great amount of time devoted to visiting the Government Departments, as well as to the absence of several of the authors, they were mostly read by titles only.

By Prof. M. D. Ewell: "A new form of graphological microscope," and "Standard glass and speculum metal centimetres."

By Prof. W. A. Rogers: "The relations between a mikron and a wave length of sodium light."

By Dr. Wm. C. Krauss: "The microscope as a factor in the diagnosis, prognosis, and treatment of morbid new growths."

By Dr. Veranus A. Moore: "Apparatus for holding cover-glasses when staining."

By Miss V. A. Latham: "The use of stains, especially with reference to their value for differential diagnosis."

By Dr. Lucien Howe: "Floating particles in the eye a source of error in microscopical observation," and "The mechanical stage used as a micrometer."

By Prof. Simon H. Gage: "Notes on the fixation of serial sections and the collodion method in histology," and "Preparation of the fibrin filaments of blood and lymph, and of the oxyhæmoglobin crystals of Necturus."

By Prof. John Michels: "The microscopical examination of pork by the U. S. Government."

At the conclusion of the morning sesssion, the society was declared adjourned *sine die*, after having spent one of the most enjoyable meetings ever held. The time and place for next year's meeting will be determined by the Executive Committee and hereafter announced.

Manufacturers' Exhibition.

Fine exhibits of microscopes, objectives, accessories, microtomes, mounting instruments and materials, lenses of all descriptions, cabinets for slides, microscopical literature, and mounted objects were made by the following well-known dealers in microscopic supplies:

By Messrs. Bausch & Lomb, of Rochester: Microscopes of their own make, together with all microscopical supplies, objectives, microtomes, books, etc.

By Dr. L. D. McIntosh, of Chicago: Microscopes, microscopic attachment for use with solar or artificial light for projecting or photographing objects, solar stereopticons, slides, etc.

By Mr. Joseph Zentmayer, of Philadelphia: Centennial, army, histological, and student stands, objectives, microtomes, nose-pieces, general slides, and other supplies.

By W. H. Walmsley, of Philadelphia: Large Photo-Micrographic Camera, enlarging, reducing, and copying camera combined, "Handy" camera, lantern slides, plates, and objects. Photo-micrographs, the work of Rev. J. D. King, of Edgartown, Mass.

By Williams, Brown & Earle, of Philadelphia: 7 microscopes, 2 microtomes, accessories, objectives, eye-pieces, mounting materials, and other microscopical supplies.

By Lyman Deck, of Salamanca, N. Y.: Heliostat.

Saturday.—The Excursion.

The visiting microscopists were tendered an excursion to Mount Vernon, the home of General Washington, by the local Society. Leaving the foot of Seventh street on the steamer *Macalester* at 10 o'clock A. M., they started down the Potomac, passed the historic city of Alexandria, and shortly after 11 o'clock landed at the beautiful home of "the Father of his Country." After several hours of enjoyment, the members returned to Washington much pleased with the kind reception afforded them in this city of science, art, and "magnificent distances."

The list of members registered during the convention is as follows:

F. L. James, St. Louis, Mo.
W. J. Lewis, Hartford, Conn.
L. D. McIntosh, Chicago, Ill.
Robt. Reyburn, Washington, D. C.
J. G. Garretson, Buffalo, N. Y.
J. M. Lamb, Washington, D. C.
V. A. Latham, Ann Arbor, Mich.
F. W. Kuhn, Fort Wayne, Ind.
R. Siemon, Fort Wayne, Ind.
H. F. Startsman, Rochester, N.Y.
C. H. Denison, Brooklyn, N.Y.
A. F. Bartges, Akron, Ohio.
Lyman Deck, Salamanca, N.Y.
L. M. Eastman, Baltimore, Md.
W. H. Walmsley, Philadelphia, Pa.
J. M. Stedman, Durham, N. C.
J. Lingley, Allegheny, Pa.
R. J. Nunn, Savannah, Ga.
Ed. Huber, Baltimore, Md.
C. C. Mellor, Pittsburg, Pa.
Thos. Taylor, Washington, D. C.
J. M. Yznaga, Washington, D. C.
Lucien Howe, Buffalo, N. Y.
D. S. Kellicott, Columbus, Ohio.
G. Guttenberg, Pittsburg, Pa.
E. W. Claypole, Akron, Ohio.
F. A. Rogers, Brewster, Mass.
Geo. E. Fell, Buffalo, N. Y.
A. P. Ecker, St. Louis, Mo.
G. N. Acker, Washington, D. C.
H. A. Robbins, Washington, D. C.
H. L. E. Johnson, Washingt'n, D.C.
J. F. Scott, Washington, D. C.
S. H. Gage, Ithaca, N. Y.
Mrs. S. H. Gage, Ithaca, N. Y.
M. A. Booth, Longmeadow, Mass.
O. E. Platt, Cincinnati, Ohio.
S. Wagenhals, Fort Wayne, Ind.
Jona White, Brockton, Mass.
C. B. Gilbert, Washington, D. C.
M. A. Spink, Indianapolis, Ind.

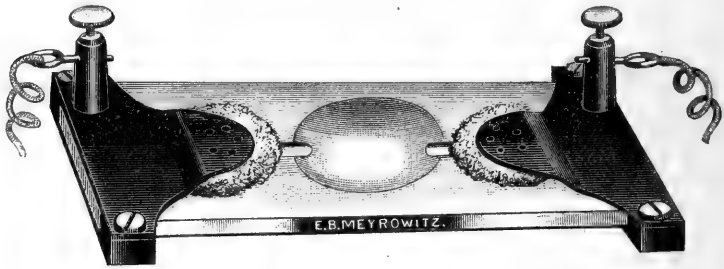
Electro-Microscopic Slide for Testing the Antiseptic Power of Electricity.

By ROBERT L. WATKINS, M. D.,

NEW YORK, N. Y.

The accompanying cut represents an instrument that I have devised for the purpose of ascertaining whether or not electricity will destroy the life of germs. It is the result of a number of experiments to confirm the belief, I have long held, that electricity is an antiseptic and disinfectant. I also learned while experimenting that Apostrali had made the same claim.

The instrument consists of a glass slide in the centre of which is a sunk cell. Two grooves, each $\frac{3}{4}$-inch long, run from this cell outward. Two brass pieces are fitted over the extremities of the slide in such a manner that the rounded points, the under surfaces of which are lined with platinum, will cover a portion of the grooves. These rounded points do not touch the glass, but are raised above the grooves about $\frac{1}{8}$ of an inch. Binding posts are riveted to the brass for connection with a battery.



SLIDE FOR TESTING THE ANTISEPTIC POWER OF ELECTRICITY.

In order to apply this instrument, a sufficient quantity of the fluid containing the bacteria should be used to fill the cell and grooves. A cover glass is placed over the cell and its contents. Two small clean sponges, saturated with either the fluid or distilled water, are then placed underneath the platinum points and in contact with the fluid in the grooves. The bacteria are now ready for observation, the electricity is turned on and the quantity noted by the milli-ampere meter to stop all signs of germ life. They can now be cultivated on gelatine in the ordinary way should it be desired to determine whether or not their vitality has been entirely destroyed.

Other uses for this slide will readily occur to one working in this field; for example, the effect of electricity on the blood and different tissues.

I have found this instrument very satisfactory, not only as an easy but as a quick way of finding out the amount of electricity required to destroy micro-organisms.

The Germ Theory.

By E. H. GRIFFITH,

FAIRPORT, N .Y.

The germ theory of disease is generally supposed to be new, and I do not now recall any one who knows it was advocated prior to 25 years ago. About a year ago, however, while visiting an old Curiosity Shop at the foot of Pike's Peak, Colorado, I found a book published in 1720, at "The Bishop's Head, St. Paul's Church-Yard, London, Eng.," written by Benjamin Marten, M. D., and entitled "A New Theory of Consumption." In this volume I discovered many things which may be of interest to the readers of the *Journal*, therefore I venture to give a few extracts from its pages. Dr. Marten writes:

"But what this peculiar, primary, or effective cause of consumption really is, doubtless will be very difficult, if possible, to ascertain; however, modern discoveries and microscopical observation may assist us in our enquiries, give us some light into it, and warrant the following attempt:

"The original and essential cause of them which some content themselves to call a viscous disposition of the juices, others a salt acrimony, others a strange ferment, others a malignant humour—all of which seem to me dark and unintelligible—may possibly be some certain species of animalculæ or wonderfully minute living creatures, that by their peculiar shape, or disagreeable parts, are inimicable to our nature, but however, capable of subsisting in our juices and vessels, and which being drove to the lungs by the circulation of the blood, or else generated there by their proper ova with which the juice may abound, or which possibly being carried about by the air may be immediately conveyed to the lungs by that we draw in, and there being deposited as in a proper nidus or neft, and being produced into life, coming to perfection, or increasing in bigness, may by their spontaneous motion and injurious parts, stimulating and perhaps wounding or gnawing the tender vessels of the lungs, cause all the disorders that have been mentioned. * * *

"This opinion of animalcules or exceeding minute animals that are inimical to our nature, being the cause of consumption of the lungs, will doubtless seem strange to abundance of persons, and especially to those who have no idea of any living creatures besides what are conspicuous to the bare eye."

After giving several pages descriptive of animalculæ and of the investigations of others, Dr. Marten continues:

"And DeAudry, a famous physician of Paris, has wrote an admirable treatise of insects in human bodies, approved by the late King's physician and the whole faculty of Paris, wherein, speaking of animalculæ, or very minute living creatures, he says: 'We must admit, then, that there are animals a thousand times less than a grain of dust, which we can scarcely see. These animals have a motion like other animals; they have muscles to move, tendons, and an infinite number of fibers in each muscle, and, in fine, blood and animal spirits very subtle and fine to fill or move those muscles, without which they could not transport their bodies into different places. The small seeds of insects do not

only insinuate themselves by means of the air and aliments, but they likewise enter the flesh by the outside. * * *

"Thus we may possibly account for several diseases to which we are liable. This may be one way by which the small-pox is conveyed from parents to children, from generation to generation, which disease I am not only apt to think is primarily caused by inimicable animalculæ, but also verily believe it may certainly be prevented, especially in adults, by destroying the very essence of the distemper, whether it be some species of animalculæ, or its ova, as I have conjectured. * * * I conjecture that it is very possible several distempers may be caused by animalculæ. * * * It may not be improbable that several species of animalculæ, flying or swimming in air, may, at their largest growth and utmost perfection, be so wonderfully minute as to be capable of entering into our bodies. * * * One species of animalcules, by their wonderful smallness and injurious parts, may instantly offend the brain and nerves, and cause apoplexies and sudden death; while other species may produce the plague, pestilence or malignant fevers, small-pox, etc.; and others, again, chronic diseases, such as hypochondria, melancholy, vapors, gout, scurvy, rheumatism, evil, leprosy, consumption, etc. * * * Blancard, in his Physical Dictionary, tells us: 'The microscope tells us the parts of the blood are sound, but that in fevers it's full of worms.' Etmuller says: 'An universal plague is foretold by unwonted swarms of insects resorting to a country.' * * *

"Dr. Winder, in the Philosophical Transactions, writing of a murrain in Switzerland, states: 'On the borders of Italy a murrain infected the cattle, which spread further into Switzerland, the territories of Wurtemburg, and over other provinces, and made great destruction amongst the cattle. The contagion seemed to propagate itself in a blue mist that fell upon those pastures where the cattle grazed, insomuch that whole herds returned home sick, being very dull, forbearing their food, and most of them would die in twenty-four hours. Upon dissection, were discovered large and corrupted spleens, spachelous and corroded tongues; some had angina malignas. Those persons that carelessly managed their cattle without a due respect to their health, were themselves infected, and died like their beasts. I am assured by two travellers that this contagion reached the borders of Poland, having passed quite through Germany, spreading near two German miles every twenty-four hours, continually making progressive voyages, suffering no neighboring parishes to escape.'"

Next Dr. Marten calls our attention to the fact that the Bible gives description of animalculæ:

'The plague of leprosy mentioned in Holy Writ affected not only the Jews, but their clothes, and the very walls of their houses, and was known by greenish or reddish streaks eaten into their walls, etc.'—*Leviticus, 14th chapter.*

I have given only extracts from this exceedingly interesting volume, but they are enough to prove that in 1720 the germ theory was not new, for the author refers us to a volume, supposed to be nearly 6,000 years old, that describes the growth of bacteria without the aid of special ovens regulated to certain temperatures, and gelatine or other delicate cultivation.—*Medical Age.*

Introduction to Elementary Biology.

By HENRY L. OSBORN,
HAMLINE, MINN.

Part IV.—Tissues.

(*Continued from page 175.*)

The Unit of Bodily Structure.—Cells in all multicellular animals or plants are the actual units performing the work of whatever kind done by that being. We use language, ordinarily, in a manner which obscures this fact, for we say that the dog runs, or the bird eats, or the potato produces starch, the tree produces fruit, and the rose produces flowers. The ambiguity in this case is parallel with that where we say that the sea produces fish, the town produces shoes, and a district produces wheat. Strictly speaking, the ocean does not produce fish, but fish perform that act; nor does a town produce shoes, but the shoemakers do it. To come back now to the dog; when we say the dog jumps we think of the mental aspect of the act and the result, and ignore the muscular and nervous phenomena involved. To make the jump mean what and all it is, we must push our enquiry back of the obvious change of position, to the causes as we can know them by studying dog-structure, and this will bring us to nerve and muscle. Both inference from analysis of the actions of animals and plants and direct examination of all physiology, when it is possible, make it certain that all activity in living bodies depends on the protoplasm in its various component cells and is an aggregate of work. Our present enquiry will be into tissues, the basis of the varied activities of the higher animals and plants.

Tissue as Cell-Aggregate.—We have learned from yeast, Protococcus, Spirogyra, Amœba, Vorticella, and others that cells divide, and thus propagate their kind. In these cases the cells are separate more or less completely from each other and thus each has an equal chance to exercise its various powers of motility, sensation, metabolism, and reproduction. Cells keep on dividing, but probably not without limit, for it now seems likely that conjugation must occur in many cases, at least to rejuvenate the flagging powers of cells which have been reproducing by fission for a long period, or they will lose the power and finally die of old age. This point, however, is disputed, and there are those who positively declare for the absolute immortality of all protozoa. The consequence of fission on the part of cells, located so that they cannot separate, would be the heaping up of piles of cells, all more or less alike. Such a state of things can be observed in many developing eggs of animals and plants, and such an aggregate of cells is *a tissue*. In many of the lower plants and animals, only a small number of tissues enter into the structure of the body. Thus, for example, in Chara and the seaweeds, also in the sponge and Hydra the body of the adult plant or animal is composed of only a few tissues, but these of vastly numerous cells.

Tissues with different Functions.—The different cells of any single tissue are all alike, both in shape and in function, and are unlike those of other tissues. The consequence of the aggregation of similar cells is that the minute results of the action of one cell are multiplied by the number of cells into an important total. Thus, for example, sup-

pose the protoplasm of a set of cells, to select the power of metabolism for special exercise, and in particular the power of producing starch, and further that the cell store inside its own wall, the starch so formed and hold it there, these cells would be recognizable as starch-producing and storing tissue. Such a tissue forms the bulk of the potato tuber, a valuable food for man, and another somewhat similar tissue is the liver of animals, such as the sheep, dog, bird, fish, and others. Or the chemical product formed by the cell's action, if the cells have specialized the metabolic power, may be a substance to be used in the construction of a solid frame-work, which may be the cell-wall, thickened as in the wood cells of plants, or a substance deposited in meshes between the cells as in the bone, or cartilage or tendon of animal bodies. While the various similar cells of a tissue thus specialize one power, and by their immense number make a total very vast in comparison with their individual bulks, other sets of cells forming other tissues are performing other collective activities, and securing equally important results of other kinds. The example of another kind of tissue is furnished by the ciliated cells lining the roof of the mouth of the frog, and also the bronchial passages to the lungs. In this case we have hundreds of cells forming ciliated tissue, each cell carrying hair-shaped prolongations, which specialize the fundamental power of motion; the aggregate work of these cells is a constant current outward from the lungs.

Division of Labor—Organism Defined.—Tissues are the result of a division of physiological labor whereby certain groups of cells in a living body perform chiefly only one of the numerous powers of protoplasm, and, having its chief energy directed in this one direction, the other powers being exercised slightly or not at all, perform this function better than it could if exercising all powers equally. The principle of division of labor is well understood in man's social life. Men can supposably perform all forms of work, both mental and physical with greater or less success, but the regular and constant performance of any one form improves the power of performing that form of work. So cells can supposably do many things, but certain sets doing regularly certain forms of physiological work become capable of doing it better. Just as men have many needs when living together in a great social organization, and certain sets work, to satisfy some needs, while others, to fill other demands, so the tissues in a living body, being numerous and variously located, perform a variety of functions all calculated to further the well-being of the sum of tissues. An organism can now be defined; it is a community of tissues, each tissue performing part in the life of the whole—giving and getting—affecting by its health or disease the organism and affected by the health or disease of the whole. The living body whether animal or plant is a microcosm, the units are the cells. The only cases which are not included under this statement are the unicellular animals or plants where no tissues can be properly said to exist.

Co-ordination.—Since the bodies of the higher plants and animals are thus seen to be organisms composed of many different parts, and since some are very complicated by reason of the large number of parts, it is easy to see that some systematic arrangement of the various labors of the cells will be of advantage to the organism as a whole. And we find that the tissues are combined in any bodies into organs for the per-

formance of definite purposes, and these form systems, the various organs of which so interact as to utilize the activity of each to the best advantage. The regulation of the various activities is called *co-ordination.* It is a form of activities of the function of irribility, and is present in some degree in all beings, but is most perfect in the highest. Thus, for instance, the human heart is an organ chiefly composed of motile tissue or muscle. The heart has such a shape that when the muscle contracts fluids in it will be expelled; to cause the expulsion in the direction most favorable to the work of all the tissues of the body, valves of tendinous tissues are placed in various parts of the heart; but, further, the amount of fluid expelled will depend on the degree of contraction of heart tissue, and this on the degree of activity of the cells, which will in turn depend on the degree to which they are irritable, and that to which they are irritated. Now, the other tissues need to have the heart expell varying amounts of blood; when they are all at rest, as in sleep not very much blood is needed; but when a good deal of work is being done by any tissues then much is required. Unless some connection is established to adjust the heart's work and the tissues' work, the heart may overwork, or the tissue be imperfectly supplied, or both. In the highest animals the mutual operations of tissues are very perfectly adjusted to each other, so that there is none of what mechanics would call lost motion. We have a second good illustration of co-ordination in the digestive system. We do not secrete saliva all the time, but only when we need it, as when we are about to eat something or are using the mouth in speech. The eye secretes abundant tears if we get some dust in it, and these help us to remove the cause of irritation. The pancreas and all digestive glands work only when they are being used, and rest at other times. Their co-ordination makes this possible.

Resumé. We have now considered protoplasm and its powers, the cell and the mode of cell activity, the consequence of the aggregation of cells in large masses in tissues, division of labor and co-ordination.

[*To be continued.*]

Sterilized Milk for the Poor.—The Brooklyn Diet Dispensary now furnishes, for the use of hand-fed infants or adults requiring it, the best quality of cow's milk, thoroughly sterilized, in small Soxhlet bottles, containing sufficient milk, when diluted, for two feedings.—*Brooklyn Med. Jour., July, 1891.*

The Healthy Tonsil Does not Absorb—Experiments recently made by Eugene Hodenpyl, and recorded in the *Am. Jour. Med. Sciences* for March, 1891, tend to show that the surface of a healthy tonsil does not readily absorb substances brought in contact with it. Such substances as olive oil, melted lard, lanoline, carmine, etc., were smeared over the tonsils of animals, allowed to remain from fifteen minutes to an hour, and then the animals were killed, and a microscopical examination of the tonsils made. In no case had any absorption taken place.

But if the epithelial layer be destroyed, or greatly thinned, and thus the substance be brought into contact with the lymphatics, absorption takes place.

TECHNIQUE.

Method for Fixing Preparations Treated by Sublimate or Silver (Golgi's Method.)—Sig. A. Obregia gives a method for rendering preparations treated by Golgi's sublimate or silver procedure so permanent that they may be afterwards stained and protected with a cover-glass.

The sublimate or silver preparations are sectioned without any imbedding or after having been imbedded in paraffin or celloidin. In the latter case care must be taken not to use alcohol weaker than 94 or 95 per cent., at any rate for the silver preparations. The sections are then transferred from absolute alcohol to the following mixture: 1 per cent. gold chloride solution, 8–10 drops; absolute alcohol, 10 ccm., which should have been made half an hour previously and exposed to diffuse light. After the sections are deposited therein the vessel containing them is placed in the dark. The silver is gradually replaced by gold, and the mercury changed into gold amalgam. Finally, black delicate designs appear on a white field. According to the thickness of the section, the fluid is allowed to act from 15 to 30 minutes, but even longer is not harmful. Thereupon the sections are quickly washed first in 50 per cent. alcohol, then in distilled water, and finally in a 10 per cent. solution of hyposulphite of soda, in which, according to their thickness, they remain from 5 to 10 minutes. A longer immersion bleaches too much, so that the finer fibres disappear. Last of all they are thoroughly washed in distilled water twice renewed.

Sections thus fixed can afterwards be stained by any method—*e. g.*, Weigert's, Pal's, etc.—after which they are cleared up with creosote, imbedded in damar, and protected with a cover of glass.

Throughout the procedure the sections must be manipulated with glass instruments, and not allowed to touch any metallic substance.—*Virchow's Archiv., cxxii (1890.)*

New Method of Injecting Fluids into the Peritoneal Cavity of Animals.—In the issue of the *British Medical Journal* for June 6, 1891, Dr. A. F. Stevenson and Dr. D. Bruce describe a method for injecting fluids into the peritoneal cavity without danger of wounding the intestines with the point of the hypodermic needle. The needle is curved, its anterior half being solid, while the posterior part is hollow, the opening being in the middle, *i. e.*, at the junction of the two halves. It may be fitted to any syringe. When using it, the abdominal wall of the animal is pinched up with thumb and forefinger of two hands, and then the needle plunged through until the middle (the opening) is in centre of the pinched-up tissue. Hence, when the skin is relaxed the opening of the needle is freely within the peritoneal cavity.

Three Useful Staining Solutions.—Dr. R. Haug gives in *Zeitschr. f. Wiss. Mikr., viii (1891)*, the three following formulæ for staining solutions which are stated to be extremely effective:

Hæmatoxylin in acetic acid-alum. 1 grm. of hæmatoxylin is dissolved in 10 ccm. of absolute alcohol, and this mixed with 200 ccm. of liquor aluminis acetici (German Pharmacopœia—see also "Extra Pharmacopœia). The fluid, at first violet-black, becomes brownish-black in the course of a few weeks, and its maturation may be hastened by the addi-

tion of a few ccm. of saturated lithium carbonate solution. It is advised to overstain the preparation with this solution, and to decolorize with hydrochloric acid-alcohol. The sections are then placed in tap water until they become blue. Any contrast dye may be used afterwards.

Alum-borax-carmine with acetic acid-alum. This gives similar but better results than alum-carmine. It is prepared by rubbing up 1 grm. carmine with 1 grm. borax and 2 grms. ammonia-alum, and then boiling this with 100 ccm. of lig. aluminis acetici for half an hour or longer. It is then decantered, and after 24 hours filtered.

Ammonia-lithium-carmine with ammonium chloratum. This gives a fine, deep strawberry red color in 1–3 minutes Overstained sections may be differentiated with hydrochloric acid-alcohol. Afterwards they are placed at once in absolute (picric) alcohol. It is prepared by rubbing together 1 grm. carmine with 2 grms. ammonium chlorate, and boiling in 100 ccm. water. When cold, to the solution are added drop by drop 15–20 ccm. lig. ammonii caustici and lithium carbonicum from 0.3 to 0.5. Filter. The solution is ready for use at once, and is very permanent.

Fixation of the Stain in Methylen-blue Preparations.—Prof. A. S. Dogiel finds that the addition of osmic acid to the picrate of ammonium solution used for fixing methylen-blue is attended with several advantages, not the least of these being that it hardens the tissue just a little, and, secondly, that it stains the medullary sheath of nerves black. The solution is made by adding 1 or 2 ccm. of a 1 per cent. osmic acid solution to 100 ccm. of a saturated aqueous solution of ammonium picrate. The stain is fixed by immersing the preparation for 18–24 hours in the mixture. It is then transferred to glycerin, diluted with water, in which the color of the nerves will keep for quite a long time. Should it be necessary to impart a consistence to the object so that it may be sectioned, the author uses a greater quantity of osmic acid (25–30 ccm. ammonium picrate solution; 1–2 ccm. 1 per cent. osmic acid). In this solution the object remains for 24 hours, after which it may be imbedded, *e. g.*, in elder-pith, liver, etc., and sectioned.—*Zeitschr. f. Wiss. Mikr., 1891.*

Artificial Preparation of the Sphæroliths of Uric Acid Salts.—Herren W. Ebstein and A. Nicolaier say that if some uric acid be dissolved on a microscope-slide in a dilute alkaline solution and watched with the microscope, there is, after slight concentration, a formation of round particles of urates varying in diameter from 2–100 μ. These are mixed with needes, either singly or in bundles. As solvents, sodium hydroxide, potassium hydroxide, lithium carbonate, borax, ammonia, and piperazine were used; the best results were obtained by using the uric-acid sediment from human urine.

With the polarizing microscope between crossed nicols the sphæroliths showed a right angled black interference cross, the arms of which lay parallel to the polarization planes of the nicols, and, concentric with the middle point of this cross, colored interference rings were seen.

Similar sphæroliths were obtained with sodium hydrogen carbonate, so that they may consist either of acid or normal urates.

The interest of such an observation, as bearing on the formation of urinary calculi, is pointed out.—*Virchow's Archiv.*

Medical Microscopy.

By F. BLANCHARD, M. D.,
WASHINGTON, D. C.

Germ-Free Drinking Water.—We now know enough about the causation of disease to be certain that a large proportion, particularly of intestinal diseases, are due to organic impurities in drinking water.

To provide healthy drinking water for dense populations is one of the most difficult problems of sanitary engineering.

While the engineers are solving the problem, and while Philadelphia, Chicago, and Cincinnati are trying to make filthy water fit to drink, it is well enough to remind the individual that, as far as the home circle is concerned, each family may be safe at this point by a very simple expedient, viz., boiling all the water used for drinking purposes.

Strain or filter ordinary hydrant water, to remove coarser impurities; boil it for half an hour in the family tea-kettle; put it in a clean receptacle; cool it by packing ice *around* it, not by putting ice *in* it, and you may be tolerably certain that there are no disease-producing germs left in the water.

When you go away from home, the problem becomes more complicated. You must either take your chances, or go to greater trouble to be safe. Coffee is safe. Whisky is worse than bacilli. The sidewalk pump and the "old oaken bucket" are reeking abominations. The public drinking fountain—who knows what diseased lip has touched the cup just before you?

Away from home, as well as at home, if you want to be safe, boiled or distilled water is still your best drink.

Phagocytosis.—The impression gained from looking over our exchanges is that Metschnikoff's doctrine of phagocytosis is gaining ground in the estimation of bacteriologists.

Peroxide of Hydrogen.—If we may believe all that we read just now about peroxide of hydrogen, this antiseptic leaves little to be desired as a purifier of ulcers, abscess cavities, etc. The trouble is, we don't know how many of these testimonials are paid advertisements, and how many are honest records. But we are giving it a trial, and we advise the brethren to do the same.

A Danger in Using the Serum of Dogs' Blood.—When the serum of a dog is mixed with human blood, or when human serum is mixed with dog's blood, morphological changes are induced in the red blood corpuscles, and a peculiar substance is precipitated, which, theoretically, might be the cause of embolism.—*La France Medicale.*

"There may be valuable curative agents discovered among the products of bacterial activity, but I have never believed that a disease will be cured by the administration of the very poison which is causing the disease. I say I have never believed in this, but I am open to conviction on this point, and take much interest in the study of the results now being reported from all parts of the world, as well as in my own observation of the effects of the proposed cure. So far, however, I have seen no sufficient reason for any change in my belief on this point."—*Dr. Victor C. Vaughan, Bacteriological World, June, 1891.*

EDITORIAL.

Washington as a Scientific Centre.—The fact that Washington is the scientific, as well as the political, centre of America has been made more evident than ever before by the successive gatherings here of scientific men during the present season.

The American Medical Association met here in May. In August came in quick succession the American Microscopical Society, the American Association for the Advancement of Science, and the American Geological Society. During the present month another series of medical meetings will be held here, viz., the Association of American Physicians, the Congress of American Physicians and Surgeons, and the American Dermatological Association.

Thus far all of these meetings have been eminently successful as regards the numbers in attendance, the character of the papers read, the accession of new members, and the scientific enthusiasm displayed. We have yet to hear of the first complaint that delegates and members in attendance have not received cordial welcome here.

Now the selection of this place of meeting by so many bodies of learned men is not a matter of coincidence. They came here drawn by the law of gravitation. The medical men found here the largest medical library in the world, and one of the finest medical museums in the world. The microscopists found here scores of men enthusiastic in their specialty. The men of science generally found a wealth of specimens illustrating all departments of human knowledge such as no other city of America can show. We speak in no spirit of selfish boasting. These treasures are the property of the American people—free to be used by the humblest who has use for them. Come, and come again.

—o—

Morbid Histology.—We have received a package of excellent photo-micrographs taken by Asst. Surg. W. C. Borden, U. S. Army, stationed at Jackson Barracks, New Orleans, La. The series illustating the different stages of pulmonary tuberculosis are particularly good. The work done in this line at the present day makes the product of former years seem insignificant.

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.—WM. E. LOY, *Sec'y.*

July 15, 1891.—President Wickson in the chair and a very good attendance. After the completion of the routine business, Ed. M. Ehrhorn gave the society some observations noted by him a few weeks ago concerning the reproduction of the shield-back grasshopper, a species of *Thyreonotus* (probably *T. dorsalis*), found in immense quantities this year in Siskiyou county. He remarked that a broad fence of a quarter of a mile in length was so completely covered by these insects that in no place could a vacant space the size of one's hand be seen. Every morning these wingless grasshoppers crawl upon the fence to bask in the sun, from which position they spring to the ground on the slightest alarm, or when approached within five or six feet by man.

Later in the day they descend to the ground in search of food, and again toward evening, or about 5 o'clock, they resume their position on fences, outbuildings, or anything on which they can perch.

Mr. Ehrhorn carefully noted the habits and peculiarities of this *Thyreonotus*, and several very fine specimens of both male and female served to illustrate his remarks. The eggs, he says, are deposited in very hard ground, at a depth of about one inch below the surface, the female working for hours to prepare a receptacle. The number of eggs deposited by each female is from thirty to fifty. Like other species of grasshopper their appearance in very large numbers in a locality seems to be the result of favorable climatic conditions. Last winter being a very mild one in Siskiyou county, the eggs were not destroyed by the frosts, as they frequently are, and consequently nearly all hatched out last spring. Although countless millions of eggs are now being deposited, should next winter be a severe one, so large a proportion would be destroyed by the frosts that the grasshoppers would be scarce.

Mr. Riedy exhibited a new projection lantern last evening, designed for educational rather than exhibition purposes. It is provided with an oil lamp, instead of the oxy-hydrogen burner usually employed, and while the volume of light was not intense, it illuminated some objects through the microscope quite successfully. The ordinary lantern lens, with suitably-prepared slides, gave excellent results.

August 5, 1891.—President Wickson in the chair. After the reading of the minutes, R. W. Baum, M. D., was elected to regular membership, and two applications were received, which took the usual course.

The committee appointed to consider the desirability of holding a series of public receptions, reported in favor of changing the character of the meetings of the society, making the first meeting in each month one of business and the reception of such papers as might come before it, and the second meeting in each month in the nature of a *conversazione.* It is further intended to make each alternate *conversazione* a public one, to the limit of the society's rooms, invitations to be issued by the committee. The suggestions were adopted in their entirety, and the committee was made a Committee of Arrangements, to continue in office until the close of the society's fiscal year in February next.

The paper of the evening was read by Dr. M. C. O'Toole, on "Embryology and Reproduction," a subject which has had his closest attention and most careful study for years. By way of introduction he traced the recorded observations and theories on this interesting branch of biology from the time of Democratus, in the fifth century before the Christian era, to the present. Aristotle taught at Athens two centuries later theories on this subject which, considering the time in which he lived, may be looked upon as simply marvellous, if not prophetic. His views differed very generally from all naturalists who had preceded him and from those who followed for the next two thousand years. Viewed in the light thrown on the subject by modern investigation, by the aid of the microscope, it is now seen how exact were all his conclusions.

In recent years biologists have been actively engaged in the study of comparative embryology, and the knowledge thus gained has solved

many of the hitherto unknown problems of zoölogy. The remarkable phenomena observed received their explanation in Darwin's theory of descent, and are accounted for by heredity and variation.

Much of this interesting paper was of a technical character, but its various points and conclusions were well taken, and its delivery was keenly appreciated. Dr. O'Toole exhibited various preparations by the aid of the microscope, which served to elucidate points in his paper. At the conclusion a unanimous vote of thanks was tendered him.

G. O. Mitchell exhibited a recent gathering of pond water from Mountain Lake, near the Marine Hospital, which contained thousands of specimens of *Volvox globator*, one of the most beautiful and interesting of all fresh-water algæ. This algæ is rare in this vicinity, and search has been made for several years by our local observers without success. Ten or twelve years since it was noted and shown at one of the society's meetings by Colonel Kinne, but it was not until the present time that its presence was again known. This only proves the persistent recurrence of phenomena in nature, which have been observed in both the animal and vegetable kingdoms. For a period of years the absence of favorable conditions and environments seems to completely obliterate certain forms, when suddenly their presence in large numbers is noted.

NOTICES OF BOOKS.

Studies on the Action of Dead Bacteria in the Living Body. By T. Mitchell Prudden, M. D., and Eugene Hodenpyl, M. D. New York, 1891. D. Appleton & Co. (Reprint from *N. Y. Med. Jour.*)

As often as once in five years a radical revolution takes place in the Republic of Bacteriology. First, the Microbe was Dictator, then Ptomaines and Leucomaines held a joint directory, and now Chemotaxis is nominated for president.

Chemotaxis is the reaction, positive or negative, attractive or repellent, between lowly, motile vegetable organisms and certain substances that exert a chemical action on them. The motive of the first paper is to insist that often too much attention is paid to the germ-cell, and too little to the body-cell.

The second paper is a record of experiments made by the authors to determine the chemotactic power of dead tubercle bacilli when injected into the cellular tissue, pleura, peritoneum, and veins of rabbits. After these injections, the bacilli, still capable of being stained by the ordinary methods, were found in various organs of the body, encapsuled by nodules of newly-formed tissue closely resembling the miliary tubercle. Aseptic, localized suppuration was produced. No living bacilli were found, showing that the injected material had been thoroughly sterilized.

Similar experiments made with the dead germs of several other diseases failed to show any similar nodular growths, from which the authors conclude that this power resides in and is peculiar to the bacterior-protein of the tubercular bacillus. A wide range of possibilities is suggested. The literary style of the articles is of a high grade.

Artesian Wells and Water Horizons.—By Louis Woolman, Overbrook, Pa. 1891. 8°, 12 pp.

This pamphlet, which is a reprint from the annual report of the State Geologist for 1890, treats of artesian wells and water horizons in Southern New Jersey and their relations to an immense diatomaceous clay bed having a maximum thickness of 300 feet. One plate is included, showing the diatoms at 90 diameters. This work is very interesting and will be very useful to lovers of this branch of microscopy.

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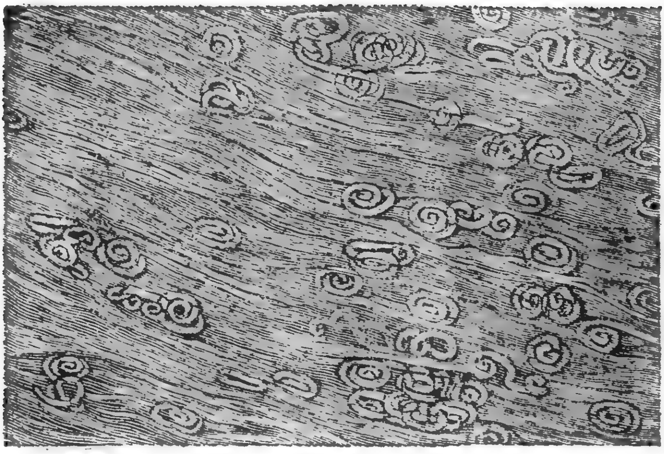
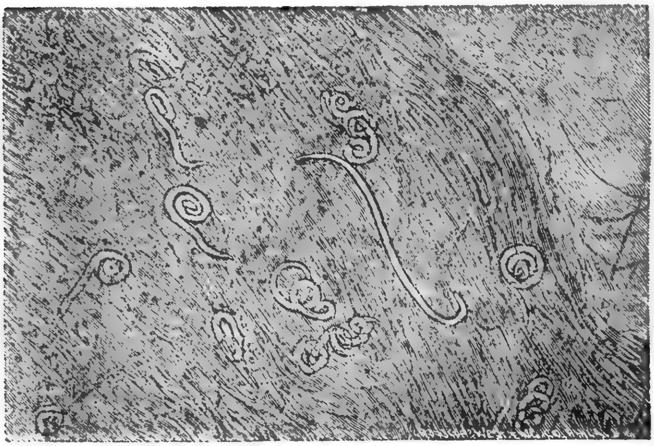


SPECIMEN TAKEN FROM THE DELTOID MUSCLE OF A THIRTEEN-YEAR-OLD GIRL WHO DIED FROM TRICHINOSIS.



ANOTHER SPECIMEN FROM THE SAME CASE.

LENGTH OF THE TRICHINA STRETCHED 1-30 INCH. THICKNESS 1-700 INCH.
MAGNIFIED 33 DIAMETERS.

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Trichina Spiralis.

BY DR. H. M. WHELPLEY, PH. G., F. R. M. S.,

ST. LOUIS, MO.

The *Trichina spiralis* is one of the most interesting of the entozoa (animals living within another). It is classified among the namatoid (thread like) helminths (worms), and derives its name from a resemblance to a spirally twisted hair.

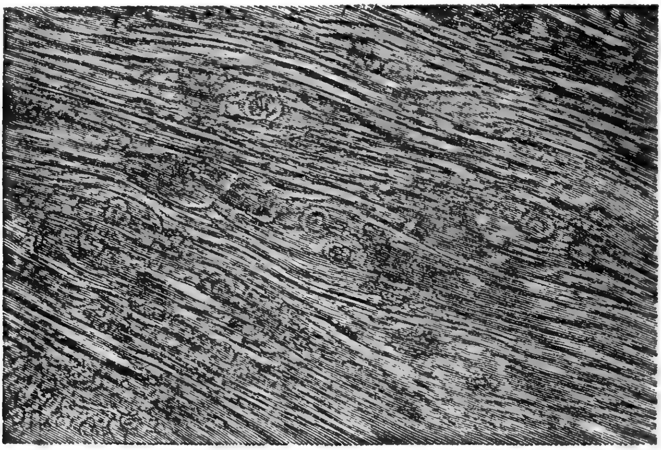
Description.—The individual worm as found in the flesh of animals is asexual and varies in size from 348 to 1270 micromillimeters (1-73 to 1-20 inch) long by 26 to 40 micromillimeters (1-960 to 1-640 inch) thick.

Trichinæ have been found in human beings, hogs, cats, dogs, rats, mice, badgers, hedgehogs, eels, moles, and chickens. It is reasonable to suppose that they may occur in any carnivorous animal. After the animal has been infected with the parasite for a time varying from a few months to one or two years, the helminths become incapsulated with a hard calcareous lemon-shaped cyst. This is probably a conservative act of nature to protect the muscle from the foreign body and the trichina remains passive in the process of encysting. Some authorities state that the cysts from human flesh can be distinguished from those found in hogs on account of having a nodule at each end of the capsule, but I have been unable to verify the statement. The worms may be present in flesh to the extent of over two hundred thousand to the cubic inch. During the stage of existence just mentioned the trichinæ are in a condition to live as long as their host retains vitality. After the death of the animal forming their home, the little fellows will survive many trials of hardships. Maceration in water does not affect them, even when continued for weeks. They have been known to survive a temperature of 165° F., and at 25 degrees below zero became quite active

(probably in an endeavor to keep warm). The smoking or salting of the flesh does not insure their death.

Discovery.—Authorities conflict in their statements regarding the discovery of trichinæ. It is probable that Professor Owen, of England, was the first to examine and describe the worm. The specimen was sent him from the dissecting or post-mortem room of St. Bartholomew Hospital, where the dissecting knives were dulled by the cysts. This was in 1834 or 1835. It is also asserted that the ancients knew the parasite and some hint that Moses was aware of their existence in the pork of that day.

Trichinosis, trichiniasis, trichinatous disease, and trichinal disease are various terms used to designate the affliction caused by one animal eating the flesh of another containing trichinæ. The disease was first described by Professor Zenker, of Dresden, in 1860. As soon as a person has eaten of flesh containing the parasites the digestive process sets them free in the stomach, from whence they pass to the small intestine. Here they become sexual within forty-eight hours, the female becoming slightly larger than the male. Within five or six days the females give birth to living young at the rate of one thousand to each female.



SPECIMEN TAKEN FROM PORK WHICH CAUSED THE DEATH OF A GIRL AND HER MOTHER.

By this process a person who has eaten one-half pound of infected pork may become the unwilling host of thirty million small filamentous embryo within a few days. The animal causes intestinal disturbances which manifest themselves as abdominal pains, vomiting, and diarrhœa. The growing young trichinæ soon find their way into tissues and traverse the muscles to their tendonous terminations. The patient usually has an elevation of temperature at this time and it is not controlled by quinine.

Owing to the peculiar fibrous formation of the heart the trichinæ never enter its substance and they are seldom found in any of the muscular organs. After the trichinæ have travelled as far as they can in the muscles they curl up and remain quiescent until the flesh is disturbed by the death of the host. Pains similar to rheumatism may

trouble the patient the rest of his life. One attack of the disease does not render the victim proof against further invasions, and successive attacks may prove fatal when the first is outlived.

Treatment is not very satisfactory to either physician or patient. If the case is diagnosed in time active cathartics and emetics will remove the young from the intestinal canal and lessen the dangers. Carbolic acid, benzine, and other volatile liquids have been proposed and used, but without beneficial effect. Picric acid has been given until the patient was colored yellow, but the trichinæ did not mind it. This is certainly a case where an ounce of preventative is worth a pound of cure, and the best treatment is to make a microscopical examination of the meat before eating it or else cook it thoroughly.

Examination of Meat.—The examination of flesh for trichinæ is by no means difficult. The trained eye can distinguish the cysts without the aid of a microscope. A lense with a power of ten diameters will show them plainly. When the trichinæ are free it requires a power of about forty diameters to make them out well. To study the animal necessitates much higher powers. A few fibres of the flesh can be picked out and squeezed between two glass slips and then examined in this condition. A few drops of glycerin will facilitate the work. I have never found it necessary to stain the specimen or treat it with ether to extract the fats as some recommend. I make it a rule to keep specimens in glycerin and see that the use of alcohol is avoided.

The diaphragm is as likely to be infected as any portion of the animal and is a convenient muscle to examine.

The statement has been made that one out of every seven human beings is affected with trichinosis. At one time I examined twenty cadavers from a dissecting-room and found trichinæ in but one subject.

The above facts have been brought together on this occasion for the purpose of stimulating the pharmacists to prepare for the examination of pork.

The illustrations are from specimens prepared by Dr. Eugene A. Rau, of Bethlehem, Pa.

REMARKS.

Mr. Willett asked: "What food will produce trichinæ in rats?"

Dr. Whelpley explained that trichinæ are transferred from one animal to another by cats devouring mice and rats, or *vice versa*, mice and rats devouring cats or hogs.

Mr. Spilker asked in what section of St. Louis the rats on which the doctor reported in his paper had been obtained.

The reply was, a 25 lot was obtained in the northern section and an 8 lot was obtained in the neighborhood of Morgan street.

Mr. Giesick inquired how it happened that in a family sick from trichinæ, two or three would die and the balance get well.

Dr. Whelpley replied for the same reason that two or three children in a family sometimes die from whooping-cough and the balance get well.

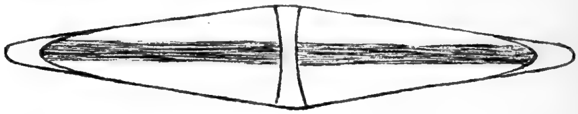
Carnoy's Modification of Lang's Formula.—Water, 100 parts; acetic acid, 5 parts; bichloride of mercury, 5 parts.—*La Biologie Cellulaire.*

Stauroneis Phœnicenteron.

By WILLIAM N. HASTINGS,

NASHUA, N. H.

The accompanying drawing is of a diatom which I have for several years been calling S. phœnicenteron. There are but two valves of it, and as they are close together on the slide, were probably from the same frustule. The diatom measures 310μ, or about $\frac{1}{80}$ of an inch. The sides are absolutely straight, as represented. It is the only example I have ever seen, though diligent search for others has been made in the brook from which it came.



If this is S. phœnicenteron, the one represented in *Micro. Dictionary*, plate 15, fig. 43; *Bulletin of Tor. Bot. Club*, 1889, plate XC, fig. 6; *Amer. Mo. Micro. Journal*, May, 1891, fig. 5, and perhaps elsewhere, is not.

Is S. phœnicenteron so rare a plant that another has been mistaken for it, or is this a new diatom?

Absence of Cancer Among Jews.—According to an English journal, a lecturer at Owens College, Manchester, recently asserted "that no Jew or Jewess has ever been found to suffer from cancer," and that "the immunity of the Hebrew race from this terrible scourge is attributed to their abstinence from swine's flesh."—*Good Health.*

———o———

Italian Itch.—It is reported that the inhabitants of Norristown, Pa., are alarmed at the rapid spread of a contagious disease called the "Italian itch" or "scabies," occasioned by the presence of a minute parasite transmissible from one person to another. The disorder here is affecting all classes alike, and the best families and most refined people are among the sufferers.

It is traced to the imported Italian laborers who have recently been employed in this neighborhood, and has spread both up and down the line of the Philadelphia & Reading Railroad and along the line of the new Trenton cut-off from Morrisville to Glenloch. Wherever these Italians have been they have left this trail of annoyance and suffering behind them.

Notes and coin are said to be most frequent means for its transmission, first from the Italians to the shop-keepers and then to the people generally. The soft parts of the skin between the fingers and about the wrists and elbows are most frequently affected.

The Microscope in the Investigation of Burns and Scorches on Textile Fabrics.*

BY FRANK. L. JAMES, PH. D., M. D.,

ST. LOUIS, MO.

MR. CHAIRMAN, LADIES AND GENTLEMEN: The subject which I have chosen for my address is one that has partly a popular and partly a scientific interest, as is meet in a mixed audience like that which usually assembles to listen to the annual addresses of our presidents. The experiences therein related belong to the domain of legal *expertise*, and are in a line not hitherto exploited, so far as I am aware. In my investigations I was necessarily compelled to stray into paths in which the microscope did not directly play an important part, but in which it indirectly and finally proved to be the agent of saving a human life, and establishing the innocence of one unjustly accused of one of the most heinous crimes known to man—the cold-blooded and cruel murder of a young wife about to become a mother. The steps by which this result was obtained justify the title of my discourse. To make these plain, a narration of the events will be necessary.

It was in the early spring of 1890 when Charles F. Vail, a young business man of St. Louis, and his wife, a young and beautiful woman, to whom he had been married less than a year, left the house of a relative, with whom they had been spending a few days, to take the railroad for home. The country house was some distance from the station, and a spring-wagon had been brought to the gate to convey them and some members of the family thither. The wagon was turned so that the "hound" projected sufficiently to make a stepping point, and Mrs. Vail started to climb to the seat. Her husband, standing behind her, assisted her to rise, but just as she was about to step from the hound up to the seat she lost her balance, turned, and fell backward, throwing her husband, who was of slight build (while she was large and solidly built), against the hind wheel. A muffled report was heard, and Mrs. Vail fell into the arms of her husband, shot through the body. She was carried into the house of her relative, where in the course of a few hours she died. On examination it was found that a Smith & Wesson pistol, thirty-two calibre, old style, had exploded in Vail's overcoat pocket, as he claimed, by striking against the rim of the wheel.

The matter was regarded as an accident at the time, by all the eyewitnesses, and Mrs. Vail died protesting that it was such. In a few days, however, ugly rumors were set afloat. It was discovered that Vail carried accident and other insurance upon his wife to the amount of upwards of $20,000. It was also discovered that there had been a romance connected with the marriage of the couple, and that they had been married for several months before Vail would consent that the fact should be published. These and other rumors caused the insurance companies to refuse to pay the policies.

Without going any further into the minutiæ of the case, there was an autopsy held upon the deceased, the coroner's verdict implicated Vail, and he was thrown into jail. At the preliminary examination he was remanded without bail, and subsequently indicted for murder.

* Presidential address delivered before the American Society of Microscopists, at Washington, D. C., August 11, 1891.

As usual in such cases the newspapers made the most of the sensation. Both Vail and his wife were well known in the city, and were well, even highly, connected. Upon the face of the evidence adduced at the preliminary examination, as manipulated by the reporters, Vail was presented to the public as a fiend incarnate. He was tried, condemned, and executed by the newspapers, all of which in the city vied with each other in concocting or unearthing some piece of circumstantial evidence that went to prove that Vail had carefully planned the murder months beforehand. The insurance companies employed the best legal talent in the city to aid the public prosecutor, and, as usual in cases where large sums are at stake, detectives, as well as men ready to perjure themselves for a fee, were not wanting. So numerous and apparently well-authenticated were the published reports of former attempts of Vail to murder his young wife that there was scarcely a man, woman, or child in the community that did not look on the prisoner as the most diabolical of villains. Even I was so firmly convinced of his guilt that I told his attorney when he called upon me for my services as expert, that I believed his client a monster for whom hanging was too good. Even the eye-witnesses, who at first declared the shooting accidental, had turned against the unfortunate, and now denounced him as a murderer.

Only his mother and sister, father and brother, and his faithful friend and attorney, Mr. Marshall McDonald, believed in his innocence. Every other human hand was against him. Every other human being clamored for his blood.

Vail repeatedly told in interviews and otherwise his version of how the tragedy occurred. His pistol, said he, was lying on the bureau in the room which he and his wife had occupied. His overcoat pocket had been ripped in some manner, and his wife had just finished mending it when the wagon for the station was announced. He hastily put the garment on, and picking up the pistol dropped it loosely in the right hand outside pocket. hammer down, and handle upward, intending to change it after they were under way. Unfortunately for him and his wife, however, he did not have the opportunity of doing so. "It struck against the wheel," said he, "and went off; how, I hardly knew myself. It was very muddy at the time, and the wheels were full of the peculiar clayey soil of the place. If I could get my overcoat, it would surely show what I say to be true."

Unfortunately for the prisoner the overcoat had been taken from his possession at the preliminary examination, and was held by the prosecution, who resolutely refused to allow the defence even to see it, much less to have it in their possession.

As the time for the trial drew near, the attorneys for the defence saw clearly how vital for their cause became the possession of that coat. No one but the prosecuting attorney knew where it was, and he would not tell. Finally, Mr. McDonald, the leading counsel for the defence, learned that it was locked up in a certain place in the property room of the Criminal Court, and after he had exhausted all legal forms of getting hold of it, he determined on a desperate course, to wit, to break into that property room and take the coat. It might be burglary, and he might be disbarred and sent to the penitentiary for it, but his client's life hung in the balance, and believing that the end justified the means, he successfully carried out his plan.

The disappearance of the garment from its accustomed place was soon discovered, and the newspapers again pretended to see in it the sinister hand of the assassin making way with proofs of his guilt.

Within a few hours after its capture it was delivered to me for a minute and critical study. It had evidently been worn and handled a good deal since it passed out of its owner's hands. It had even been carefully brushed (as was afterward proven at the trial, a party having testified to having worn it while on a ride of several miles across country, and having cleaned the mud off before starting and after coming back).

The problems presented to me were:

1. To discover, if possible, the remains of the clay that was rubbed off the wheel by the coat.

2. The relative position of the pistol in the pocket; that is, whether it was resting hammer upward or hammer downward.

3. The relative position of the pocket toward the balance of the garment, or, in other words, whether the pocket was hanging naturally, or whether it was thrust upward by the hand and brought near the point of exit of the ball when the shot was fired.

4. As a corollary to the foregoing, whether the muzzle of the pistol was jammed into the corner of the pocket, as would be contended by the prosecution, or whether it was a little way from the corner.

5. Whether the muzzle of the pistol was in close proximity to the lining and body of the garment at the moment of explosion, or some distance from it.

The first question was easily settled with a loupe, amplifying about two or three diameters. Under the nap of the garment, away from the effects of brushing, remains of the band of clay were found. But how to settle the balance was another matter.

The coat itself was of chinchilla cotton warp, and heavy wool weft; the lining was of silk and cotton stuff, faced with satin. The pocket was of heavy twilled wool and cotton goods. There was some cotton batting, and finally some heavy linen stiffening, "buckram," I believe the tailors call it, and the ball, in its flight, and a portion of the flame had passed along all of these, which embrace, as stated, cotton, linen, silk, and woollen fibres, or nearly all of those used in textile fabrics. Both the ball and the flame must have left a record of their path. That of the former was comparatively easy to trace. It had torn a triangular hole in the corner of the pocket and had emerged from the chinchilla just where the satin facing was sewed to it, making a clean, round hole not much larger than a small lead-pencil, or say a quarter of an inch in diameter.

You will understand that in such examinations the expert is not allowed to mutilate the garment in any manner, except by order of the court or by the consent of all parties in interest. Under the circumstances, we could get neither of these, and hence the examination was rendered far more difficult than it would otherwise have been.

On turning the pocket inside outward I found on either side of the same, near the bottom, a faint stain, which, so far as inspection with the naked eye went, might have been caused by iron-rust, by liquids, or by a scorch. Constant handling and rubbing of the walls together had worn off all charred material. With the tube of the microscope removed from the stand, and armed with a two-inch eye-piece and a

two-inch objective, examining the surface by direct light, I could discover little or no evidences of powder-burn as usually seen. With the aid of the glass, however, I was able to trace out the exact limits of the stain and its shape, which was that of a figure 8, or rather of two circles, each about seven-eighths of an inch in diameter, overlapping each other at one point about one-quarter of an inch from their peripheries. The centres of these circles seemed somewhat more deeply eroded than the balance, but even then there were no tell-tale ends of burned fibres.

If these are burns or scorches, I asked myself, how came they in this position in the pocket, and how were they caused? An examination of the pistol, or rather of an exact duplicate of it, at once gave the clue. If you will examine any of the repeating fire-arms of the Colt, Remington, or Smith & Wesson patterns, you will note that between the muzzles of the revolving cylinder and the barrel there is a small space, say the fiftieth of an inch, left intentionally by the makers to allow for expansion of the parts under heat, and to insure free revolution of the cylinder. In firing the weapon, no matter how narrow the space, some of the inflamed gases must here make their escape, and will leave their record on any substance in close proximity to the weapon.

What sort of a record must this flame leave? A little reflection will show that this will depend largely upon the breadth of the space through which the jet of inflamed gas makes its escape, upon the "quickness" of the powder, upon the nature of the substance burned, and upon the pattern of weapon used; but, in all events, it will be a very superficial one—a mere scorch. There will be no actual burn such as we find on surfaces "powder-burned" from the close proximity of the muzzle of a discharging weapon, simply because no unconsumed or partially consumed and red-hot powder can escape through the aperture.

What should be the shape and size of this scorch? This I determined partly by geometrical methods and partly by experience. Assuming from known facts in physics that the escaping gas would not shoot outward as a narrow belt of flame of the thickness of the aperture, but that immediately on issuing from this aperture it would spread and assume a pyramidal form, the base of which constantly widens up to a certain point (which depends, of course, upon the intensity of the jet), but that its greatest energy would remain in a line—in this case a circular plane, passing at right angles through the axis of the weapon. If there were nothing in the way, nothing to break the force of the jet, it is plain that if a surface, a sheet of paper for instance, be placed parallel to the axis of the weapon folded, and touching the cylinder, we should have, upon discharging the weapon, a mark on the paper somewhat similar to an hour-glass, intense at the point nearest the source of the flame, and gradually weakening and fading the further off therefrom. In actual practice, however, there are three sources of modification of the shape of the scorch. The first in the broad cap and bottom pieces which unite the barrel and the stock, and between which the cylinder revolves; the next is the pivot on which the latter revolves; and, finally, the shape of the cylinder itself. For practical purposes the latter can be ignored, but the two first-named put an exact limit to the area of the scorch, obstructing as they do, and cutting off the path of the flame, and giving us two oval scorches touching or overlapping each other and forming a more or less accurate

figure of 8. Experiments made with 100 pockets similar to the one in the coat confirmed these speculations with the utmost nicety.

This fact once established, we are enabled to locate with great exactness the position of the weapon. A line drawn through the longer axis of the figure 8 above noted, will give the position of the weapon when it was discharged.

Taking a pocket that had been made by the tailor who made the coat, and of exactly the same stuff that was used in the original pocket, after scorching it by discharging the pistol, placed hammer downward (by striking the hammer with a tack-hammer through the cloth), I carefully unravelled some of the threads from the scorched portion, after first taking the precaution to rub the surfaces together long and vigorously, and beating to remove all traces of char. I examined the fibres in glycerine, first with a half-inch objective and a two-inch eyepiece, and afterward with a one-fifth-inch objective, to determine what structural changes had been wrought in the wool fibres of which the filament was composed. The first, the half-inch, instantly showed that on the side exposed to heat the wool fibre had become opaque, and in places considerably thickened, warped, and twisted. The area and depth of the opacity were in direct ratio to the amount of heat applied. The one-fifth-inch objective showed the same general features, and in addition demonstrated that the opacity was due to a sort of stratification or splitting up of the cortical portion, and a granulation of the medullary structure of the wood. The color of originally white (bleached) fibres was changed by the scorch to a reddish brown by transmitted light, which was quite brown by direct light. At points where the char was deep the color was dark-brown, or even black throughout. Such fibres were greatly thickened, and broke easily. At points where fibres were charred through, the ends were split, the outer envelope curling or being retracted backward and the central portion reduced to a granular mass.

Cotton fibres examined in the same manner showed discoloration at the point of contact with the flames, merging from coal black through various gradations of brown. They were twisted and broken, and where burned through the ends were black, square, or even slightly concave. Much charcoal, in a minutely divided condition, was found among them. This was due to the preliminary rubbing to remove the completely carbonized portion. Occasionally, especially in charred cotton batting, a whole fibre would be found completely carbonized, but retaining the characteristic shape.

After I had settled these points, I carefully withdrew from the stained portion of the pocket of the overcoat, so as to leave no mark of mutilation, a few pieces of the thread, and examined them exactly as I had done the foregoing, and found identically the same appearances.

I was now in a position to swear most positively that the discolored surface was a scorch made by the escaping inflamed gases from the space between the cylinder and the barrel of the pistol.

Placing the pistol in another and exactly similar pocket, hammer downward, and discharging it with a tap from a tack-hammer as before, I carefully noted the position of the axis of the scorch and found it to coincide, within a quarter of an inch, with that in the original overcoat pocket.

By placing the pistol in the pocket, hammer upward, and marking the position of the space, I found that the latter was some two inches higher than the centre of the other burned area, and that its axis was inclined at a different angle from that of the said area. Experiment, by firing the pistol in a pocket exactly similar in size and shape, confirming this point, and I was enabled further to swear most positively that the pistol was lying hammer down in the overcoat pocket at the time of its discharge.

The next point to settle was whether the pistol was fired by hand. This was easily demonstrated to have been impossible, by experiment with the weapon in similar pockets, and I need not dwell upon the matter here.

How far, in all probability, was the muzzle of the pistol from the point of exit of the ball, was the next vital question. This was also solved experimentally; but before the experiments could be accepted as evidence the microscope had again to be resorted to. The silk lining of the coat had not been attached to the hem of the garment, and hence it was a comparatively easy matter to turn the latter wrong side out. On the one side was the silk and cotton stuff used for coat lining, on the under side of which cotton predominated. A strip of buckram extended some six inches from the margin of the coat inward and protected the satin trimming from the action of the flame. The buckram, from its closely twisted nature, showed but a slight discoloration, which might or might not be due to flame. The lining also showed but slight traces of discoloration. Coming to the chinchilla, however, there was an area of about six inches in diameter that, while showing no char to the unaided eye, had evidently been subjected to some denuding influence.

Placing the surface as flat as possible and in a strong direct light, I first went over it with a Coddington lens, but beyond the fact that there were points where the threads were cut and broken by the impact of some substance, I arrived at no direct and positive evidence which would enable me to swear positively that the denudation of this area was due to flame. The round bullet hole in the centre and the character of the other marks rendered this conclusion very probable, it is true, but absolute certainty was what I wished to obtain.

Again, before resorting to the expedient of secret mutilation of the garment, though never so slightly, I resorted to experiment. Taking a piece of chinchilla exactly similar to that used in the overcoat, probably a remnant of the same bolt, as it was procured from the tailor who made the garment, I hung it up in such a manner that it would offer the same resistance to the passage of a bullet as the stuff in the garment. I then put the pistol in a pocket exactly similar to that in the coat, and discharged it by a slight blow upon the hammer (which latter rested, of course, upon the cartridge, which latter was one exactly similar to that in the pistol at the time of the accident). The muzzle was about six inches from the chinchilla. The discharge made the characteristic marks in the pocket, the characteristic tear in woollen and cotton-twill material, bored a ragged hole about three-quarters of an inch in diameter through the chinchilla, and made a burn about four inches in diameter. Taking the chinchilla and rubbing it until pretty much all the char had been removed, I passed it backward and

forward over a stage prepared for the purpose over which I had mounted the tube of my stand, armed with a two-inch eye-piece and a two-inch objective. The "stage" was simply a wedge-shaped block of wood eight inches long, three inches high, and four inches wide at the bottom. The width narrowed toward the top to one inch and was then smoothly rounded off. The bottom was grooved lengthwise with an ordinary grooving plane. This block sat on a plane board eight inches wide and sixteen inches long, to which was bradded, down the centre, a tongue which fitted into the groove on the bottom of the block. The "stand" consisted of a percolator supporter, with an arm bearing a wooden clamp which held the tube-carrier sufficiently firm for my purpose. Adjustment was made as in the old Nachet stands, by sliding the tube carrying the lenses up or down with a slight rotary motion. Finer adjustment was obtained by touching the arm with the finger.

On examining the surface of the stuff by a strong direct light, I had no difficulty in finding pits in the material, in which, in many instances, I found unburned or partially burned grains of powder. The ends of the thread plainly showed charring, and presented the same general appearances, when withdrawn and examined separately, as those already described in the cases of wool and cotton. The bit of chinchilla now gave place to the coat itself, and with considerable difficulty I went over the whole denuded surface around the bullet-hole, hunting for grains of imbedded powder. Cavities where they *had* been were plenty, but the grains themselves had long since been rubbed or shaken out. Finally, however, my search was rewarded by finding two cavities close together, each of which contained a grain of powder. With a pair of delicate forceps I removed a couple of the cut threads between these two cavities and examined them separately, after tearing them out to get at the fibre. They were cotton, and very strongly charred.

I was now in a position to swear most positively that the whole of this denuded area was due to char, or scorch, or burn, from the discharge of a fire-arm. I say the *whole of the area*, and emphasize it, because thereon hangs one of the most important points of the defence.

In any series of experiments where the same weapon and the same charge are used, each time the area of the scorch is in direct ratio to the distance of the muzzle of the weapon from the surface scorched. This may be accepted as an axiom; and, as a corollary, we may add that the depth of the scorch and penetration of the powder will be inverse ratio to the said distance.

These facts furnish us with an accurate scale by means of which, having a similar weapon and a similar cartridge, we may determine, within a margin of an inch, the exact distance from any powder-burned surface at which a shot was delivered.

In the present instance, experiment proved that the muzzle of the weapon was not more than eleven nor less than nine inches from the point of exit. This was corroborated in a singular manner by the character of the hole made by the ball as it left the overcoat. It was, as I have stated, a smooth, round hole, about one-quarter of an inch in diameter. By actual experiment, many, many times repeated, we subsequently proved that eight inches from the muzzle of the pistol, under

the circumstances, being fired each time through a heavy twilled pocket, was the nearest distance at which the kind of cartridge used could possibly make a smooth, round hole. The hole becomes more jagged and larger, the nearer the muzzle approached the cloth, until when in actual contact (as it was claimed by the prosecution *was* the case in the shooting of Mrs. Vail) a great hole, from two to three inches in diameter, is blown bodily through the stuff, leaving the latter torn in every direction, and almost always on fire.

These points being settled, I next examined the buckram, or heavy linen stiffening. The fibres of this material gave the least evidence of change under the scorching influence of the gas. There were no powder marks or cavities, and the most that I could discover was a slight deposit of soot on the outer side of the thread. In buckram scorched by experimental discharge, the threads unravelled and picked to pieces showed no structural changes. The burned ends of fibres are always conical and opaque for a short distance back from the burned portion. From its exceedingly hard and closely twisted nature this is what we might expect.

A piece of fine linen cambric, unstarched, scorched by the side flash from the aperture between the muzzle of cylinder and the barrel of the pistol, was far more strongly marked. There were no detectable structural changes, but the fibres were deeply burned on the exposed side, sometimes down to more than half their diameter, and in a few instances burned through.

A piece of the same cambric, starched and smoothly ironed, under similar circumstances, was not nearly so severely marked.

It is, however, when we come to silk that we find the greatest and most interesting structural changes produced by scorches. When held close to the source of heat (the flame jet) the fibres twist and warp in every direction, at points apparently fusing together and making a network that can be compared to nothing more aptly than to the figure produced by cutting little lines of slits in paper, each line of slits breaking joints with its neighbor, and then opening the paper out—after the fashion of the "expanded metal" screens of the present day. At points burned by partially combusted powder or other glowing matter, the whole mass of fibres constituting a thread end, actually fuse together, making a solid mass, from brown to black in color, and often containing small bubbles of gas. The fibres swell and become opaque, sometimes granulated.

To sum up:

Wool fibre becomes opaque on the side exposed to the flash, thickens in diameter, warps, and frequently twists on itself. The depth of the opacity is in direct ratio to the amount of heat applied. The opacity is found on examination with higher powers to be due to a splitting up of the cortical and a granulation of the medullary structure. In black-dyed fibres the thickening and distortion are the same as in white fibres, but the degree of opacity cannot be observed.

Cotton Fibres.—These are more easily affected by a flame jet than any others examined by me. They show a discoloration at the point of contact with flame, merging from jet black (carbon) to a faint brown through all gradations of brown. When burned through and subjected to rubbing or manipulations, the end is left either square or slightly con-

cave. Investigations, not mentioned in the foregoing, show that cotton that has not been manufactured, crude yarn still retaining the oil, warps and twists under heat, and displays more tendency to increase in volume than manufactured cotton free from oil.

Linen and Flax.—There appear to be no marked structural changes in these fibres. The ends of a fibre burned in two and cleaned by rubbing are conical in shape and opaque for a short distance back. When not cleaned the end is rounded and has a more or less enlarged head of carbon attached. Occasionally the fibres split at the end.

Silk Fibre.—The fibre twists and warps under the effect of heat. If the latter be great, it seems to melt, and several fibres will fuse together. A brown discoloration is produced by contact with flame in all cases, and this becomes black where the flame is intense. At the ends of fibres exposed (as in silk velvet) to an instantaneous jet of flame, sometimes a small round or roundish knob is formed. In all fabrics, of whatever fibre made, the looser the weaving the more deeply the material is affected by an instantaneous flame jet. The smoother and closer the surface the less the effect and the more difficult the task of detecting old scorches where the surfaces have been rubbed.

These, gentlemen and ladies, are an outline of my work, and a summary of results. Commencing with a deep conviction of the guilt of the accused, my investigations led me first to doubt the correctness of this conviction, and afterward convinced me of his innocence. They enabled me to go into the court-room and to prove to the satisfaction of eleven men out of a jury of twelve that the prisoner at the bar, instead of an execrable villain, was the miserable victim of circumstances.

It was my intention to place these results graphically before you in the shape of photographs or colored drawings, but for many months past I have been forbidden the use of my eyes for any such work. Indeed, since New Year's day, up to within a fortnight, the use of the microscope itself has been interdicted. An attack of grippe, from the effects of which I have not yet fully recovered, left my eyes so seriously affected that any attempt to use them for more than two or three minutes at a time was always followed by severe and lasting pain.

With warm weather great amelioration has come, and I will soon be enabled to prepare the drawings for the next volume of proceedings.

A New Medium for Mounting Starches and Pollens.

By A. P. BROWN, Ph. G.,

CAMDEN, N. J.

Having occasion to mount a variety of starches for examination under the microscope, I have been looking for a suitable medium that would best show the structure and at the same time preserve the specimen. The students of the class of Microscopy at the Philadelphia College of Pharmacy are desirous of preserving the different starches that are given to them for examination during the course; but until recently I have not been able to give them, for mounting of starches, pollens, and similar vegetable substances, a medium that would have the advantage of showing the structure of the specimen after it had been fin-

ished and preserved for future reference. Balsam of fir makes starches too transparent. Glycerin is good, but it is almost impossible to find a cement that would hold it on account of its solvent properties. Carbolic acid and water in time dry out. Cosmoline has been recommended, but it is too greasy and it has the same fault as glycerin; it is almost impossible to find a cement that will hold it.

A short time ago Mr. Charles Bullock spoke to me of a new medium he had been using to monnt vegetable tissues; it struck me as being the very article for mounting starches in. I prepared some and found it to answer the purpose admirably; it is as follows:

Selected gum arabic	℥ ij
Glycerin	
Distilled water, of each	f ℥ iss
Thymol	gr. i

These are all placed in a wide-mouth bottle, which is corked carefully to exclude dust and placed in a warm situation. It takes several days to effect a perfect solution, the mixture being stirred up occasionally. When all is dissolved strain through linen and set aside the liquid about a week longer to get rid of air-bubbles and to allow any small particles that may have passed through the strainer to settle to the bottom, or it can be filtered through absorbent cotton by using a funnel for hot filtration, which consists of a double tin case holding water kept at the required temperature by a spirit lamp placed under the projecting arm. A glass funnel fits inside of the hot-water bath, a plug of absorbent cotton is placed in the funnel, and the solution is passed through it. After filtration it is best to preserve in compressible tubes.

To mount starches or pollens a clean slide is breathed on and then dusted over with the starch or pollen to be mounted; the surplus is removed by gently tapping the slide against any hard substance—a table, for instance. Enough of the starch will adhere to the slide and will be nicely distributed over the field. A drop of the mounting medium is now placed on the slide carefully and the cover placed over it. If there are any air-bubbles in the mounting medium when placed on the slide they should be carefully picked out with a mounting needle. If the medium is kept in a compressible tube there is not much danger of air-bubbles on squeezing out a drop; or if there are any, they will be on the surface, and can be readily removed with a mounting needle. The slide can be finished immediately by running a ring of any kind of cement around the edges of the cover-glass, and the mount is permanent.

The medium can be colored blue by adding a small quantity of aniline blue, although it is not necessary, as the structure of the starches can be plainly seen. They should be examined by central and oblique illumination and with the polariscope to give the student interested in this subject an idea of the beauty of starches and pollens.—*Am. Jour. Pharm.*

Slides Received.—We desire to return thanks to the donor for the following interesting histological slide:

Blood of snapping-turtle mounted in osmic acid glycerine, by Wm. N. Beggs, M. D., St. Louis, Mo.

Introduction to Elementary Biology.

By HENRY L. OSBORN,
HAMLINE, MINN.

Part V.—A Specific Life History Considered Biologically.—The Frog.

(*Continued from page 209.*)

The principles already stated are true of all living things, whether large or small, high and complex, or low and simple, and beings are thus all bound together into one vast realm of bodies exhibiting similar phenomena and acting under common laws. It seems paradoxical perhaps to say it, but it is none the less true that there is no power of the geranium which is not equally possessed by the elephant, and *vice versa.* The elephant cannot, it is true, cause delicate and odorous flowers to blossom on his person, the exercise of protoplasmic powers in his case are not along that line; but he can exert the same fundamental powers of protoplasm as are involved in the act on the part of the geranium. It will be well for us now to consider some common organisms with a view to testing whether it is made up of tissues which in turn are composed of cells, which again in turn are protoplasmic bodies with some or all of the fundamental powers of motion, sensation, metabolism, and reproduction. For the first case we may take the common frog. This animal is well known to everybody, has been the subject of very numerous essays and sketches, and has perhaps been more studied than any other animal in the animal kingdom.

General Sketch of the Frog.—The frog's body presents a head and trunk and four limbs, all covered with skin. The head is provided with a large mouth opening into a series of organs placed one behind the other, and forming a closed tube which lies within the space which occupies the body. This tube, which we call the alimentary tube, has various organs connected with it, and runs to the hind end of the trunk where it opens by the vent. Food which is swallowed at the mouth travels along the tube, is variously transformed, parts of it absorbed, and the remainder passed away through the vent. The trunk cavity, besides containing the alimentary tube, contains various other organs—the heart, situated at the level of the front limbs, is connected with a system of tubes which collect absorbed food from the alimentary tube and carry it thence to all parts of the body, as, for instance, to the brain, muscles, and to the various organs connected with the alimentary system. The food used in the body gives rise to waste products which must be removed to make room for fresh useable ones, and the lungs are present in close connection with the blood circulation to remove carbonic acid gas from the blood and put fresh, pure oxygen in its place, and remove another waste product called urea. The heart forces the fluid through all the system of tubes, and thus prepared food is taken from the alimentary tube to all the organs and their waste products carried away from them. Besides these systems closely related to the feeding of the frog's body, we have three other systems which are related to its commonly observed performances and are for more unusual employment—the supporting system or skeleton and skin, the muscular system and the nervous system, and the reproductive system.

The supporting system is a frame-work of inflexible levers and solid

pieces bound together at their joints with cords of very strong substance called connective tissue. The muscles are organs stretched from bone to bone (or used in other places) which, by their contraction, bend the joints, thus moving the parts of the skeleton upon each other. They are very numerous and are caused to move at the proper time and degree by the nerves, which together form the nervous system. It is the skeleton, muscles, and nervous system together which are concerned in the motions of the animal body, while the other systems are secondary to these. The reproductive system does not exist for the benefit of its individual possessor, but is for the benefit of the group in order that the kind may be continued after the death of the individual. We may then look upon the frog as a machine endowed with wonderful powers—with systems of levers to secure the greatest variety of movements—with living cords to pull on these levers, with nerves to guide the pulls of the various cords and harmonize their work for some useful purpose—with a complex apparatus for supplying fuel to the force-using parts of the apparatus—and a drainage system to remove all the waste resulting from the use of the fuel—and finally with an apparatus, part of the machine, which has the power of making a new machine to take the place of the old one as it wears out and finally goes to pieces. Our problem is to see if all these remarkable powers can really properly be regarded as the powers of protoplasm acting in some or several ways. Our subject is too complex to be approached except by degrees, and we will consider its various parts separately.

The Supporting System and Skin.—The skin of the frog is to our ordinary observation a damp, somewhat sticky coat loosely placed over the parts beneath ; it is dark above and almost or quite white below. If we keep a frog in confinement long enough and keep watch of it we shall see that a thin translucent film comes away from its surface as we may remove a glove. This film if perfect will retain the shape of the animal perfectly even to the tips of the toes. If we put a small piece of this film under the microscope we shall find it to be made of small flat blocks, five or six sided, forming a mosaic pavement, and if we stain the specimen with iodine we shall find a central round more densely staining portion. These are dead cells then and they form a tissue—the spot in the centre of each cell is its nucleus. This film is the outer layer of the skin. A vertical section of the skin will show this outer layer slightly thicker and yellower than those below, and several layers of cells below it, and finally a row of cubical cells forming the inner or basement layer of the epidermis. The skin is, however, composed of more than the epidermis. Below the basement layer of cubical cells we shall find connective tissue cells, ragged-looking bodies whose straggling arms connect with each other and form a layer below the epidermis. These cells are in some positions filled with colored substance which seen through the translucent epidermis gives its color to the skin at large. In certain places the basement cells of the epidermis bend down to form pockets in the dermis, pockets lined with cuboidal cells, and these are the glands which secrete the slime. Blood-vessels and nerves run up to the dermis to connect the cells of the skin with those of the inner organs, the nerves go to the brain and spinal cord, and a touch upon the skin may be followed by a vigorous jump on the part of the frog. We see then that the skin is a mass of tissues, and each

tissue a mass of cells. Let us now take one cell and compare it with amœba to see if it has the various protoplasmic properties, or some of them.

The Dermal Connective Tissue Cell.—If we could isolate a cell of the dermis and observe it as we can do amœba, we should know much which we now hardly more than conjecture; still, biologists have so much confidence in their conclusions upon the matter that they often state them as veritable matters of observation, and they are right in this, for the sum of evidence in their favor justifies it. Like amœba the dermal cell consists of protoplasm in which lies a nucleus; unlike amœba it lacks contractile vacuole, food vacuoes, and the power of motion by means of pseudopodia. The dermal cell does not react quickly, so that we cannot observe its power of motion and sensibility if it have any, as we can do in amœba, and its food is in solution so that we cannot see it taken in as we can see in ambœa. And yet there is evidence which goes a considerable distance toward proving that the dermal cell has all these powers. Let us examine the points of this evidence in order. We noticed above that the frog's body is dark above and light below; a very careful examination of the case will show that the dark color grows darker if the animal is kept in the dark, and lighter when brought out into the light, and the study of closely-allied animals, for example, the tree toad, will show some remarkable facts, for in these not only the shade of color of the dermis is some way regulated to match the surroundings of the creature, but to a certain extent also the tint whereby they so closely imitate the color of their environment as to escape observation. If we look closely into these facts we shall find them instructive examples of cell-work. First, the production of color. The blood contains none of the pigment; it is a chemical material made by the dermal cell out of materials derived from the blood; this form of metabolism is commonly called secretion; these cells manufacture and retain their secretion.

Not all dermal cells secrete pigment, and not all secrete the same kinds. The failure to secrete accounts for the white color of the ventral surface and the peculiar form of material secreted by different sets of cells gives rise to the variously-colored markings on the frog's back. In all of this we have a view of the case as involving the function of metabolism variously in different cases with the ordinary color of the frog as a result. In the second place, then, can we find any sign of motor or sensory function from the dermal cell? The fact of change of color in response to the surroundings so well marked in the tree-toad, but not wholly absent in the frog, can only be understood as a response on the part of dermal cells to an affection from without themselves, and this is by definition sensibility or irritability, a fundamental power of protoplasm (see p. 127). The fact that the response is not very quick, or the change of color very great, does not alter the argument, and we are justified in regarding this fact in the color of the frog as evidence of the possession on the part of the pigment cell of the power of irritability. The third fundamental power, the power of motility, is less obviously present in these cells, but the exercise of this function is believed to explain the mode of color change, for it is thought that by contraction or expansion on the various cells the pigment substances contained therein are displayed or concealed, or altered in amount, and so the ob-

served changes made to take place. This seems very plausible, and, if true, would be a case of motor activity in the cell. It would, however, not be surprising to find these or any cells not exerting one or more powers, and in fact the dermal cells on the underside of the body are a case in point in this connection.

Resumé.—The study of the frog's skin then reveals the presence in the epidermis of crowds of cells in which the power of metabolism is exercised in the production of slime as well as in the constant assimilation of substance from the blood to furnish the material for growth ; in the dermis of cells producing pigment responding to the surrounding, and causing color change, all of which cases show the presence in these cells of the powers of metabolism and irritability, and probably also of motion. These cases go to show how large a problem is still before the biologist before he can look at the body of an animal and by the eye of the trained scientific imagination see what each kind of cell is doing, and understand all the conditions of its action. Such, however, is the problem, the solution of which the biological world is now actively seeking.

[*To be continued.*]

TECHNIQUE.

Demonstrating Tactile Papillæ of Hirudo Medicinalis.—In order to show well, says Dr. S. Apáthy in *Zoologischer Anzeiger*, the tactile papillæ of *Hirudo medicinalis*, strong spirituous solutions of sublimate should be added to the water in which the starved animal is kept until it moves no longer. Having been stretched out with pins, 10 per cent. sublimate or 70 per cent. alcohol is poured over it. This makes the tactile papillæ stand out from the smooth ventral surface.

Examining Ova of Gordius.—In examining the yolk-stalk of *Gordius*, Sig. L. Camerano fixed this animal in one-third alcohol or picric acid. Meyer's carmine stained germinal vesicle and spot well. For ova the author recommends as fixative 3 per cent. nitric acid or a mixture of equal parts of absolute alcohol and acetic acid, and as stain, borax-carmine, or a mixture of malachite-green and vesuvin.—*Mem. della R. Accad. di Torino, xl (1890.)*

Preparing Pepton-agar for Studying Pyocyanin.—M. Gessard gives the following ready method for making the pepton-agar so useful in studying the formation of pyocyanin. In each test-tube is placed 0.25 grm. of finely-chopped agar, and then 5 ccm. of neutral 2 per cent. pepton solution and 5 drops of glycerine are added. The tubes are then heated for some time to boiling point in a water bath in order to drive out the air from the agar. After this they are sterilized for five minutes at 120° C., and allowed to set in oblique position.—*Annales de l'Institut Pasteur, 1891, p. 65.*

Simple Method for Sterilizing Catgut.—Mr. G. R. Fowler sterilizes commercial catgut by boiling it for an hour in 97 per cent. alcohol. The control experiments were made with anthrax and suppuration cocci. It was found that catgut which had been soaked in these germs was rendered perfectly sterile in an hour.—*N. Y. Med. Record.*

Medical Microscopy.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

The Disinfection of Excreta.—The *Jour. Am. Med. Ass.* for August 22, 1891, has a sound and practical article with the above title from the pen of Geo. M. Sternberg, M. D. We quote simply results.

The object of disinfection is the destruction of the germs of infectious disease. In the case of an ordinary privy vault used by healthy persons not disinfection but deodorization is needed. For this purpose solutions of sulphate of iron and chloride of zinc are useful. But when we wish quickly to destroy the germs of infectious disease, under the conditions that ordinarily exist in the sick room, especially in the excreta, aqueous solution of chloride of lime is still our best agent.

Other useful agents mentioned are carbolic acid, creolin, quick-lime and hot water. But chloride of lime holds the first place, owing to its rapidity of action. For disinfection of vaults, where rapidity of action is not so essential, quick-lime is given the first place. A short list of the literature of the subject is appended.

Antipyrine for Whooping-Cough.—Contrary to our usual custom, we refer to a matter which has no direct connection with microscopy. Antipyrine was first used in whooping-cough nearly three years ago, but its value does not seem to be generally known, and we deem it of such importance that it ought to be everywhere known. The dosage is a grain or a grain-and-a-half for a child a year old, from two to four times a day. It promptly moderates the spasms, and in many cases acts like a specific.

Cultivation of the Bacillus of Leprosy.—Experimenters at the Almora Leper Asylum and at the new laboratory at Simla have at length succeeded in making cultures on bouillon, agar, and gelatin of the bacillus of leprosy. The inoculations were made with serum from blisters on patients suffering with leprosy.—*Brit. Med. Jour. of Dermatol., July, 1891.*

Distoma Pulmonalis.—The *Sei-I-Kwai Medical Journal* for February 28, 1891, contains an abstract of a report made by Drs. Yamakiwa and Inouye, of Tokyo, on the prevalence of this parasite in some of the mountain villages of Japan. It is said that in villages where the distoma is found it is so greatly dreaded that inhabitants of other villages refuse to visit or trade, and even physicians are unwilling to go to such villages from fear of infection.

The eggs are said to be taken into the human body in drinking water, and they afterwards appear in large numbers in the sputa. We judge that the chief symptom of the disease is hæmoptysis, but the way by which the parasite travels from the alimentary canal to the lungs is not made clear by the report.

A Pointer for Biological Chemists.—Post-diphtheritic paraylsis is caused by the action on the nervous system of a chemical by-product of the bacillus diphtheriæ. Well, then, find us a chemical which, by union with this alkaloidal poison, will produce a non-poisonous substance, just as albumen unites with corrosive sublimate to form the albuminate.

Pathology of Paralysis Agitans.—Dr. von Sass, in the St. Peters-

burg *Med. Woch.*, publishes a case of this disease, with the results of post mortem examination. He found marked lesions of the peripheral nerves and in the voluntary muscles. As it is not the rule for either the peripheral nerves or the voluntary muscles to be examined in such cases, the author suggests that such investigations, systematically conducted, might disclose a peripheral cause to account for more of the symptoms than is generally supposed.

The Koch-Eberth Bacillus.—Apropos to the discussion about the Koch-Eberth bacillus and its relation to typhoid fever, we suggest that whenever a given disease represents broadly different varieties, the microscopist ought to suspect more than one bacillus. With the average practitioner the term typhoid fever covers a multitude of cases in which a diagnosis is never made. What is the essential nature of the fevers which we call "gastric" and "gastro-intestinal?"

American Public Health Association.—The 19th annual meeting will be held at Kansas City, Oct. 20–24, 1891. The local Committee of Arrangements announces that all the railway passenger associations of the country have granted a one and one-third fare rate for the round-trip on the usual certificate plan; that is, procure a certificate of attendance from the agent at the starting-point by paying full fare to Kansas City.

Have the certificate of attendance signed by the proper officer of the Association at Kansas City. This certificate will then procure return ticket for one-third fare. All the leading hotels of Kansas City will give special rates to delegates. Arrangements are being perfected for an excursion into Kansas, as one of the features of the entertainment of the Association. For any information as to the meeting, address Dr. E. R. Lewis, Chairman, or Dr. Joseph Sharp, Secretary, Kansas City, Mo.

MICROSCOPICAL SOCIETIES.

San Francisco, Cal.—Wm. E. Loy, *Sec'y.*

August 19, 1891.—President Wickson called the Society to order, and announced that the usual routine proceedings would be dispensed with, except the reception of one proposition of membership, and the election of L. M. King and C. E. Cooper, M. D., as regular members. The Society was then adjourned formally, and the remainder of the evening given to the various exhibits and discussing the same.

Henry C. Hyde, chairman of the committee in charge, briefly announced the general plan of the exhibit, and invited the members and guests to inspect the various preparations.

A. H. Breckenfeld showed a beautiful live water spider, order *Arachnidæ*, genus *Hydrachnæ*, on a dark field, which attracted a great deal of attention. Henry C. Hyde gave a pleasing exhibit of diatoms, one slide showing one hundred different species of *Naviculæ* mounted in styrax. S. E. Taylor showed a single frustule of a species of *Arachnoidiscus*, a beautiful genus of diatoms, with a low-angled half-inch objective and dark field illumination. L. M. King had on his stand

an arranged slide of diatoms prepared by Rinnböck, of Vienna. Charles C. Riedy exhibited a *Navicula lyra* with a one-fourth inch apochromatic objective and dark field.

R. H. Freund showed the only preparation of bacteria on exhibition, a species of pathogenic bacteria not identified. E. S. Runyon had a number of very attractive crystals, including the crystalizable principle from the prickly pear. Platino-cyanide of magnesium and Menthon crystals, all shown with polarized light and excellent effect. William E. Loy showed a young star-fish, *Asterium gibbosa*, with the aid of a spot lens.

The exhibition was further enhanced by brief informal addresses. Mr. Hyde gave an outline history of the *Diatomacæ*, showing first their place in botany, how generally they are dispersed about the globe, where they may be found, and a comparison of the fossil and recent forms. The peculiar structure of the diatom has preserved very perfect skeletons from the earliest geologic eras in which it is found, and when properly treated these fossils may be cleaned and mounted, yielding the most beautiful of all microscopic objects. He remarked that since the time of Ehrenberg many scientists had spent years of patient study in this captivating field, so that to-day many thousand species had been figured and described. Unlike some objects in nature, new beauties are seen with increased amplification, and the highest powers of the microscope only serve to increase the admiration of the beholder.

A. H. Breckenfeld gave a brief demonstration of the optical qualities of what is known as dark field illumination. By this method the light is thrown around and upon the object, but its rays do not enter the objective nor reach the eye of the observer. The object then is shown on a dark background, with a brilliancy not possible where the light passes directly through the object. His remarks were fully illustrated by drawings on the black-board, and proved instructive and interesting.

September 2, 1891.—Vice-President Selfridge in the chair. The Secretary reported a donation of two pamphlets to the library, from the author, "The Structure of Blood Corpuscles and Its Relation to Practical Medicine," and "Fugitive Blood Corpuscles in a case of Lymphadenoma," by J. H. Wythe, M. D., LL.D.; two parts of "Bolletino della Società Italiana dei Microscopisti," from the sister society in Acireale, Italy; besides the usual installment of periodicals and journals for the reading table.

The routine business of the evening included the election of H. M. Miner, M. D., as a regular member.

The paper announced for the evening was read by Dr. Wythe, on "The Structure of Blood Corpuscles." After mentioning his studies and researches in this branch of histology and certain recorded results, he stated that these observations extended over a number of years and had been prosecuted with the highest powers of the microscope, especially with the Leitz one-twelfth and one-twentieth homogeneous immersion glasses, and the Bausch and Lomb one-eighth of 1.43 numerical aperture.

Since then he has received a Powell and Leland one-tenth apochromatic homogeneous immersion objective, of the extreme numerical aperture of 1.50, and last evening he exhibited the blood corpuscles under that magnificent lens. He said that preliminary to the demon-

stration he desired to indicate some things which he had observed respecting the blood which may make necessary a revision of most of the text-books, and which would show what a wide field of investigation remains open to intelligent work in all directions. He sometimes feared that the brilliant progress of bacteriology had diverted the attention of observers from the more useful investigation of histological structure.

Dr. Wythe said he had found that observations of the blood were of little value unless high powers were employed, say from one to two thousand diameters, and that the more perfect are the objectives employed the more satisfactory will be the conclusions. He had used various solutions, as well as no reagent or solution at all, with very similar results; but a 50 per cent. solution of bichromate of potash gave the greatest satisfaction. Under circumstances described he had seen the most varied and complicated structures in the blood, compelling the conviction that different corpuscles serve different functions. Variations of size, of shape, and in the manner of activity or of disorganization, have been of constant occurrence. Shapes the most bizarre and strange have been often met with, so different from the conventional figures of the books as to suggest the question whether the makers of text-books had ever seen blood under the microscope of modern times.

Endeavoring to classify the various appearances of the corpuscles, he noted: First, the white corpuscles, which are generally spherical or ovoid masses, although often irregular in shape, having amœboid or changing forms, and composed of white convoluted fibres, which in lower powers or inferior microscopes seem granular. Second, flat plaques, or discs, of a white color, either round or irregular in shape. One perfectly round one had indications of radiating fibres at the edge of the disc; others were irregular, and dumb-bell shaped. Third, the red corpuscles, which are at first flat discs, either round or irregular, but mostly round. They vary in size, some being double the size of others. In a short time they become somewhat globular or irregular in form, losing their disc-like appearance, and projections like knobs appear in irregular numbers all over their surface. Sometimes in corpuscles which remain discoid these knobs or protrusions appear all round the edge. It is as if they were composed of two semi-fluid substances, like gum and glycerine, which had a tendency to separate from each other. The semi-fluid droplets have vibratile and amœboid motions, and are often seen in torula-like masses, budding and showing signs of excessive vitality or irritability. Many of the corpuscles, with their extruded globules, have a wheel-like or axial vibration from side to side. The fourth classification includes microzymes, or small particles of various sizes and shapes, in constant motion. Many of these are so like micrococci as scarcely to be distinguished from them.

The protruded masses from the red corpuscles become like micrococci with varied motions.

The importance of these observations will be obvious to students of pathology as well as of jurisprudence, and may indicate that the germ theory of Dr. Beale, which is not superseded by the discovery of specific bacteria, is yet destined to play an important part in practical medicine.

After the conclusion of this interesting paper discussions followed, in

which many additional facts and theories were evolved, and before adjournment a unanimous vote of thanks was tendered the Doctor.

Sept. 16, 1891.—A public exhibition and reception to invited guests was given by the San Francisco Microscopical Society, which proved very interesting and instructive. The Exhibition Committee had provided four large tables, on which were placed some fifteen microscopes, and objects of rare beauty were displayed.

The list of exhibits was so lengthy that it is not possible to speak of all, but the following were particularly attractive: R. H. Freund had a variety of bacteria, some from the laboratory of Dr. Koch, Berlin; Henry C. Hyde had a most interesting collection of diatoms, including a number of genus slides, showing one hundred or more different species on one slide. L. M. King showed some interesting living organisms, typical representatives of pond life. William E. Loy exhibited a number of vegetable sections, stained and double stained. George O. Mitchell exhibited specimens of marine zoölogy, the most interesting being embryo snails in the ova in motion. Those who watched this slide for a few moments were rewarded by seeing the young fry escape from their gelatinous envelope, so rapid were the changes. Charles C. Riedy showed the secondary markings on diatoms under a one-twentieth immersion objective, and the human voluntary muscle under a one-sixth apochromatic. E. W. Runyon showed a variety of objects with polarized light, and S. E. Taylor some beautiful opaque slides.

The Society intends to give these receptions at regular intervals in the future, and it promises very satisfactory results.

NOTICES OF BOOKS.

Manipulation of the Microscope. By Edward Bausch. Bausch & Lomb Publishing Co., Rochester, N. Y. 12mo., 127 pp.

This little book was written five years ago by Mr. Bausch and gives in simple language the fundamental principles of the instrument and the best method of technique. The demand for the work has been so great that a second edition has been issued, in which the author has enlarged on some subjects and rewritten others so that they will conform to the improvements of the present day. The intended purchaser of a microscope will here find much valuable information relative to the selection of his instrument.

Special Catalog über Apparate für Mikrophotographie. Carl Zeiss, Jena.

This catalogue should rank rather as a work of art than as an advertising publication. Throughout, the illustrations are elegant photograpic prints. We have seen nothing to excel the photo-micrographs of test diatoms.

The Coming Reaction in Favor of Tuberculin.—Under the above title Dr. Karl von Ruck has an able article in the *Weekly Medical Review* for August 22, 1891. The author stands squarely by the

Koch method. He criticises Prof. Senn's "Away with Koch's Lymph," and shows numerous fallacies in his methods of experimentation, chiefly in that the remedy was often tried in hopeless cases, and too large doses were used. The author's own experience with tuberculin has been very favorable, ten cases out of twenty-five having been absolutely cured.

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Introduction to Elementary Biology.

BY HENRY L. OSBORN,

HAMLINE, MINN.

PART VI.—A SPECIFIC LIFE HISTORY CONSIDERED BIOLOGICALLY.— THE FROG.

(*Continued from page 234.*)

The skin of the frog is not exhausted when we cite its slime-producing and color functions, for it serves as the medium of the sense of touch and permits the passage of gasses to and from the blood, but at the risk of being incomplete where entire completeness would be possible only at the expense of important space it will be best now to look somewhat closely at another set of organs, the ciliated cells of the throat and bronchial passages.

If the skin of the frog's throat be examined with a power of 50 diameters substances on its surface can be seen to move slowly along as if flowing in a gentle current in a definite and constant direction. The same could be seen if the tubes were large enough to inspect readily in the bronchial tubes. In these tubes the current is always up toward the throat and away from the recesses of the lungs. In consequence of this constant current particles of dust from the dust-laden air the creature breathes are moved up to and collected in the throat, whence they can be removed when they become annoying. By removing a small piece of this skin to a glass slide in salt solution and teasing it well, then covering it with a glass cover, it can be examined with a power of 300 or 400 diameters. For comparison with these teased specimens one should examine vertical sections of the skin which have been made by histological methods; by means of the two studies the facts now described can be verified. The skin of the frog's throat is composed of a pavement of minute blocks which we may compare with bricks set upon their ends. These blocks are the cells of the skin membrane. They are only one row deep. Each cell is taller than broad and five or six-sided in cross section. The cell presents one end to-

ward the throat cavity called the "outer end." The opposite end or "inner end" is toward the dermis where the blood-vessels, connective-tissue and nerves lie. The cell contains protoplasm in the centre of which is a nucleus; in the presence of these and in their chemical composition they are like cells generally or like Amœba. The outer ends of these cells are furnished with a peculiar coat of "cilia." These are minute hair-like bodies slightly curved and tapering. They are composed of protoplasm and are a continuation of the protoplasm of the cell body. These cilia are in living cells in constant motion, they wave back and forth like the oars in a row boat, but they do not all move simultaneously, some are at any instant thrown forward and others drawn back. The movement of the cilia further is a strong beat in one way and a gentle recover in the opposite way, and since the thrust of all the cilia is strong one way and weak the other they create a current in the direction of the strong thrust. Some more facts need to be noted here before we address ourselves to the task of interpreting these facts in terms of protoplasmic activity. The cilia are in a dark place, yet they are constantly at work day and night. They even work for a time after the heart stops beating and we say the frog is dead. Their action is not dependent on any direct stimulation so far as anybody knows, but they can be made to work faster or slower by application of heat or cold.

Let us now, having noted these facts, seek the interpretation of them by reference to the biological principles already stated. The motion of the cilia is in the first place plainly a case of the exercise of the protoplasmic function of movement (p. 126). The cell as a whole does not have power of movement like the amœba, but retains a constant shape and fixed outline, but the protoplasmic projection on cilia contracting alternately on either side presents this power. This act is paralleled among the low animals called infusoria, of which Vorticella is a good example. Here a single cell furnished with its circle of cilia around one end can by their aid cause a current which tends constantly in one direction in this case, furnishing food to the creature. But our comparison of the ciliated cell with vorticella will not bear pushing too far; in Vorticella the motion of the cilia is constant so long as Vorticella remains undisturbed, but directly you jar it or some little swimming creature runs against it the cilia cease their action and the Vorticella retracts upon its stem. It exhibits thus a certain power of reflex action, and can behave in response to the circumstances which may environ it. The frog's ciliated cells, unlike Vorticella, have a constant ciliary motion which not even the death of the frog can immediately affect. A certain power of cell life is thus lost or virtually lost, and we may say that the cell has no power to control the ciliary motion in response to external conditions. The case is something as we may imagine it would be in Vorticellæ, which for many generations had been in a situation where they never met any disturbance, hence never exercised their power to contract, and finally lost the power through disuse.

A knowledge of the ciliated cells shows another point of similarity between them and elementary simple animals. The individual cells have a comparatively brief existence, and yet the tissue continues and outlasts the life of the frog. This is brought about by the fact that the individual cells are constantly producing more cells by division, by

which process some young ones ready to mature are always on hand to replace older ones, products of previous divisions, which fall out of their places and give room to the younger ones. In this way of looking at a tissue we see it is like a habitat tenanted with Amœbæ. Though fatal circumstances may at any time remove large numbers of Amœbæ those that are left by division soon fill their places, and so it happens in a tissue that though the cells are constantly being lost new ones are as constantly coming up to replace. It is in this way that the tissues are constantly changing and the body is truly, as often said, a wholly new body after a certain time, which, however, must vary very much for different organs.

It is thus perfectly rational to look upon the ciliated epithelium as a tissue that is an aggregate of cells all alike in form and function, and its work as the resultant of the individual works of the component cells, and it is further perfectly reasonable to compare the ciliated cell with a unicellular animal like Vorticella, a near ally of Amœba, and to notice that its work is not at all absolutely unlike that of either of these, but in reality a special exercise of one of the powers among the several unspecialized powers of Amœba. In other words, we do not find in our study of ciliated tissue any positively unique and new phenomena of cell life, but only special applications to particular conditions.

(*To be continued.*)

The First Diatoms Published.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

As it may interest your readers to know, I find in Vol. 23 of the Philosophical Transactions of the Royal Society of London for 1704 "two letters from a gentleman in the country relating to Mr. Leewenhœck's letter in Transactions, No. 283, communicated by Mr. C." In the letter of June 21, 1703, is a description and four figures of "a creature" which is evidently *Hydra fusca*. We found it in clear water, "which I took from the ditch at W., in which, with my utmost attention, I could discover no more than this one of the same kind. Fig. I represents it in one of the postures it appeared the first day (for it varies every moment), and the knob at *a*, which looks like the gut *cæcum* was sometimes a little more lengthened; two or three days after I could perceive two or three white fibres at the end of it, and on the fourth day the animal, lying stretched at its full length, appeared as in Fig. II, and I plainly saw that what I thought an excrescence was a young one, with six horns coming out of the side of the old one, and next day I found it in water entirely separated from the body, and was about one-third the length of the parent." "The horns are perfectly white, and the body yellowish." Although neither the "gentleman from the country" nor "Mr. C." are named, we have here a first with Leewenhœck's, the first communication of the discovery of *Hydra fusca*. Leewenhœck's discovery of *Hydra fusca* is in the Philosophical Transactions for January and February, 1703, is dated at "Delft, in Holland, 25 October, 1702." He describes and figures *Lemna polyrrhiza*, as seen by him. On the roots of *lemna* are figured *Vorticella*, *Limnias*, and a Diatom, *Synedra*, as the roots "were also overgrown with a great

many particular long particles, and mostly with little figures like flowers, as they are represented in the 8th fig. between *k* and *l*. This is the first representation of a diatom I know of.

In the Philosophical Transactions, No. 284, for March and April, 1703, is "an extract from some letters sent to Sir C. H., relating to some microscopical observations communicated by Sir C. H. to the publisher." In the letter of Sept. 29, 1702, he says, "the end of last week a buck, which by mischance had his leg broke, was kill'd, tho' so late in the season, and it being rutting time I thought I might, with the greatest advantage, observe the *semen masculum*. Not to trouble you with some former attempts of this kind, as soon as he was killed I took out one of the *testicles* with the adjoining *seminal vessels*, and found the *vasa deferentia* very turgid and full of a milky fluid. After various methods of viewing this liquor, I saw the *animalca* (in prodigious numbers) very perfectly in several postures, moving very briskly, and shew'd them to others, who own'd they appear'd as plain as tadpoles to a naked eye." He figures these spermatozoa with globular heads and short tails.

He figures the *vorticella*, which Leewenhœck figures, but larger and plainer, showing that he had high-power lenses, which were made for him by Mr. Wilson. He also figures various other animalcules.

In the Philosophical Transactions for September and October, 1702, at page 1241, is "The Description and Manner of using a late invented set of small Pocket Microscropes, made by James Wilson, which, with great ease are apply'd in viewing opaque, transparent, and liquid objects, as the farina of the flowers of plants, etc. The animalcula "in semine, etc." In this he describes and figures the microscope of eight separate "magnifying glasses," in which he follows the "authority of the excellent Dr. Hook," who "assures us that single magnifying glasses (when they can be used) are preferable to microscopes composed of two or more magnifying glasses." He also figures the down from a butterfly's wing, the "farina" of malœ, tail of a fish with the veins and arteries in it, two animalcules on the tail of the fish, and "one of the lice found on the beetle, called *Scarabens pediculosus*."

But to return to the "gentleman in the country." He mentions the small plant as figured by Leewenhœck as "*Lens palustris* or *Duck meat*, which is *Lemna*," and "the *Animalcula*, which Mr. L. describes sticking to the root of the plant," which is *Hydra fusca*, but says he "was never so fortunate as to see that motion in them, which he says is like that of a mill-wheel." "But I think I can easily account for this mistake of Mr. L., or rather of his painter, for in the same water wherein I have seen these plants and *animalcula*, I have observed a small, round creature, whose many legs stand like *radii* all about its body. This has a swift, progressive motion, but will often lie still (when only you can perceive those *radii*), and then turn very swiftly round like a wheel, sometimes one way, and then stop and turn the other way, without stirring an hair's breadth forwards. Now, 'tis very probable that one of these might show its tricks so very near or among a tuft of the other fixed *Animalcula*, that it might be very well taken for part of the same, and I am very confident that this is a matter

of fact." He thus ascribes the motion of the "wheels" or *Limnias* for that of *Hydra*. He then figures and describes *Cyclops quadricornis*, and says they "all are breeders, and carry spawn at their tayl, that of Fig. 5, in two bags (one on each side), which are fastened about the fifth joint, and the other in a single bag or film under the tayl, and I have often seen these bags broken and the spawn (which is globular and large in proportion to the fish) scattered through the water."

In his letter of July 5, 1703, he described but does not figure *Volvox globator*. He say that "each of these spherical bodies (which are smaller than a mustard seed) have a constant progressive motion, and at the same time a slow revolution about their own axe, and contain within them other small globules, some more, some less, but I never found above 10 in any one, and these I have seen move and change their position within the other, which Mr. L. says he has never observed."

In his letter of July 5, 1703, he says: "In my observations of these stalks I often saw adhering to them (and sometimes separate in the water) many pretty branches, composed of rectangular oblongs and exact squares which were joyn'd together, as you may see in Fig. VII, which I drew exactly as I could from one of them. There are often twenty or more of these figures in one branch, which generally adheres at one end to the stalk of the plant, and I think it remarkable that these rectangular parallelograms are all of the same size, the longest side not exceeds $\frac{1}{3}$ of an hair's breadth, and that the length is just double the breadth, the squares being visibly made up of two parallelograms joyn'd longwise. They seem very thin, and the texture of every one is nearly the same. To a very large magnifier they appear as in Fig. VIII. I took these branches at first for salts, but finding them always of the same size, and that there was no sensible increase in their bulk while they continued in the water, that after they had lain a day or two dry on a glass plate they altered not their figure, and upon the addition of new water (warm or cold) they had still the same appearance and cohesion, and that their adherence (though touching only at the angular points) was so firm and rigid that they moved together, and kept the same position in respect to one another, however agitated by the water; these considerations, I say, persuade me that they may be rather plants than salts, but they being so very minute that no judgment can be made of 'em but by the eye, I shall not determine anything positively." These were a diatom, *Tabellaria floculosa*. Thus in Vol. 23 of the Philosophical Transactions for the years 1702 and 1703 (published in 1704) we have the first discoveries of diatoms.

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Dispora Caucasica.—From No. 16 of "Contributions from the Cryptogamic Laboratory of Harvard University" we learn that "Kephir," which is used in the Caucasus Mountains to produce an alcoholic fermentation in milk, has been discovered in this country, specimens having been sent to the laboratory from New Jersey and from Ontario. In the Caucasus the Kephir grains are said to grow in little clumps or granules on peculiar bushes found on the mountains just beneath the snow line. The grains are composed of yeast cells and bacteria embedded in a zoögloea mass. Edouard Kern published the first account of the Caucasian "Kephir" in 1881, and gave the bacterium the name of *Dispora Caucasica*.

On a Bacterial Insect Disease.

By S. A. FORBES, Ph. D.,

CHAMPAIGN, ILL.

The student of human physiology often finds his subject brilliantly illuminated by a knowledge of the far simpler physiological apparatus and functions of the lower animals—of Arthropods especially—and it has seemed to me quite possible that the pathology of these creatures might sometimes similarly interest the student of medical theory. As a first venture in this direction, I submit a description of a bacterial disease of the notorious chinch bug (*Blissus leucopterus*), a hemipterous insect about a sixth of an inch in length, the contagious diseases of
As this disease is restricted to a single part of the digestive tract, a
which are now undergoing systematic investigation at my office.
brief description of this tract will be necessary; the more so, since it has never yet been described, and because it presents some interesting peculiarities.

The alimentary canal of the chinch bug may be divided, in general terms, into five regions of greatly different importance; the œsophagus, the gastric region, the cœca, the region of the Malpighian tubules and their vestibule, and the rectum. The œsophagus is a very slender short tube, about .1 to .15 mm. long, opening abruptly into the broadly-rounded anterior end of the first stomach. The gastric region is divided into three quite distinct cavities, of which the first and largest lies in the direction of the long axis of the body, the second at right angles to it, and the third again in the direction of the first. The anterior division is slender-pyriform or ovate, broadest behind the middle, 2 to 2.5 mm. long by about 8 mm. wide in its usual condition, with a very delicate outer wall, in which is a reticulum of muscular fibres arranged in two sets, longitudinal and transverse. The latter are quite regularly placed, .02 to .07 mm. apart, closest on the anterior part of the stomach. These transverse filaments are about 4 μ wide, branch occasionally, and rarely anastomose. The longitudinal bands are less regularly arranged, frequently branch dichotomously, and anastomose variously, forming an open net-work with elongate meshes, the fibres of which vary from 3 to 5 μ in diameter.

The epithelium of this cavity is composed of a single layer of nearly spherical cells (commonly granular and semi-opaque) of irregular size and not closely crowded, varying in transverse diameter from .07 to .15 mm., and in height from .06 to .09 mm. The inner surface is consequently uneven, the cells projecting variously by broadly-rounded ends.

The first cavity connects immediately, by a narrow constriction, with the second, smaller, obovate one, which is about .7 mm. long by .5 mm. in greatest breadth. This body is lined with very large pale cells of irregular size, varying in diameter from .06 to .1 mm., and always contains a large fluid mass varying in color from yellow to dark brown, or even black, which is probably partly digested food. The epithelium is rather thicker and more nearly columnar than that of the preceding division.

This second division connects at its broad end immediately by another narrow passage, with a third cavity of similar shape, but smaller, about

.35 mm. by .5 mm., this lying with the broad end backward. From the narrow anterior end of this third cavity passes a slender tube about .2 mm. long by .05 mm. wide, which opens into the point of convergence of the eight large cœca, and from this point extends another similar tube, which rapidly enlarges into the sub-spherical vestibule of the Malpighian tubules. The cœca, radially arranged, are about .12 mm. in diameter, and average 1.5 mm. in length. They are straight, or slightly contorted, with smoothly-rounded ends, and are nearly filled, when in normal condition, with large, pale, loosely-attached, subspherical cells, similar to those of the gastric epithelium, but containing more fatty granules. These cells are variable in size, and individual ones become greatly swollen, and probably break down in secretion. The lumen of the tube is an irregular linear space, not readily distinguishable in the midst of the cells.

The Malpighian vestibule is a nearly spherical dilatation of the canal, immediately behind the cœca, about .45 mm. in diameter, the epithelium of which resembles that of the greenish tubules. The latter are four in number, about .1 mm. thick, and go off at equal distances in a radial manner. The Malpighian vestibule opens directly into the short, broad, thick-walled rectum. There is no chitinous cuticular lining in any portion of the alimentary canal except the rectum and the œsophagus.

The principal peculiarities of this anatomy are the subdivision of the stomach into three compartments—a rather unusual feature in insects of this relationship—the shortening of the posterior part of the digestive tube with the entire absence of any tubular portion, and the development of the large cœca, possibly as a substitute for the last—a peculiarity otherwise quite unknown to me in any hemipterous insect.

Curiously enough, the disease in question is strictly confined to the whorl of cœca above described, and in them has finally the effect to completely destroy the secreting epithelium, the cells of which break down and disappear, leaving the delicate tubules filled with a vast mass of microbes with some small intermixture of droplets of fat and a little nondescript *debris*, the result of cellular decomposition. The bacterial mass is always a perfectly pure culture of *Micrococcus insectorum*, Burrill, described in 1883 from the alimentary canal of the chinch-bug, and not since encountered elsewhere. This microbe is usually oval, with narrow ends, oftenest in couples, but sometimes in strings of four, six, or eight. When in strings it is likely to be shorter and more abruptly rounded at the ends. Sometimes elongate forms are seen, about twice the typical length, with no appearance of division—probably individuals in process of multiplication. It takes the aniline stains uniformly, never presents flagellate motion, and never forms spores. Undivided segments vary from .8 to 1.6 μ in length, with a uniform width of .65 μ.

In slightly affected bugs it is found within the cells of the cœca, the nuclei of which may become crammed with it; but even after the complete degeneration of this epithelium the other cells of the alimentary tract are almost absolutely free from it—a fact which can only be explained on the supposition that it is select in its conditions of growth. In bad cases it may be found free in the fluids of the posterior part of the canal, but not in number to compare with those in the cœca. In

the first and second stomachs I have rarely seen it at all. In the third stomach it may occasionally appear, but there it never attacks the epithelium. In the fluids of the body cavity, in the fatty bodies, in the Malpighian tubules, in the muscles, and in the nervous masses, it is totally wanting, even in the specimens worst diseased. Perfect slides of this bacterial species may be made by smearing diseased cœca on a cover-glass, and staining and mounting by the usual methods.

The effect on the insect is not remarkable, beyond a slowly increasing lethargy, clumsiness, and weakness, usually but not always accompanied by a swelling of the abdomen and a greenish hue of the under side of the body due to the tint of the fatty bodies within. In the later stages chinch bugs placed upon their backs cannot right themselves, but can only feebly move their legs. Death by this disease is not followed by decay or by any *post mortem* development of fungus growths. The attack is most likely to appear in the growing insect, and in the stage next preceding the adult, just previous to the last moult, a period of extraordinary susceptibility in insects generally, but adults are often seriously and even fatally affected. Although the disease is to all appearance eontagious, and occasionally destroys vast numbers of these insects together, strict proof of its transmission is yet wanting. Attempts at cultures made previous to the last few weeks have been only doubtfully successful, owing to the evident sensitiveness of this micrococcus to culture conditions, and to the difficulty experienced of getting a pure infection material. By isolating the alimentary canal of chinch bugs by dissection, and separating the cœca and transferring them entire to culture tubes of agar, beef broth, and the like, I have lately succeeded, in conjunction with Professor Burrill, in making perfectly pure cultures in considerable number in both animal and vegetable media in both fluid and solid states. As a result of the infection by this method of sixteen culture tubes containing, respectively, beef broth and infusions of corn stalks and of potato—each medium being represented by perfectly neutral, by acid, and by alkaline tubes—we have obtained successful cultures in all the neutral and alkaline fluids and in none of the acid ones, and from these fluid cultures have made transfer cultures on solid agar with entire success.

The sensitiveness of this micrococcus to acid in its culture fluid is probably the cause of its strict limitation to the cœca of the insect intestine, since these cœca do not contain any portion of the food, but serve only as a secreting gland. The secretion must be neutral or alkaline, while the partly digested food is probably acid. As the excretion of the Malpighian tubules is acid, the immunity of these structures has a similar explanation. It is a point of special entomological interest that we have in this microbe a possible test of the chemical character and physiological action of the fluid secretions of the cœca of insects—a matter yet in controversy.

Concerning the utilization of artificial cultures of the micrococcus for a propagation of this disease among insects not affected, I am at present able to say but little, as I have not yet succeeded, in either season when it was common, in finding lots of chinch bugs sufficiently free from it to make them suitable subjects for experimental attempts at its transfer. It will be readily understood by any one that it is useless to test the utility of artificial cultures of the disease germs by applying them to

insects which are already affected by the disease in question. The first step of any really scientific investigation of the economics of this matter is to determine positively the absence of the disease in the lots of insects to be used in the experiments. Every lot of chinch bugs thus far obtained by me from central, south-central, and northern Illinois during the months of July and August of this year gave evidence under critical study of the presence of this microbe in the cœca of a larger or smaller percentage of pupæ and imagos. My previous observations —less carefully made, however, than my recent ones—have been to the general effect that hibernating chinch bugs and young preceding the so-called pupa state are little liable to the spontaneous occurrence of the intestinal trouble, and I consequently do not despair of finding before the present season is over opportunity for experiments which will determine beyond question the economic value of this chinch bug "cholera."

In comparing this with similar human diseases we must take account of the poverty of the circulatory fluid of the chinch bug and the simplicity of its circulatory apparatus, which forbid the marked development of any of the phenomena of fever or inflammation. Indeed, it seems to me that insect diseases generally are characterized by the absence of a vigorous physiological reaction which their relatively lowly structure, nervous and circulatory, makes impossible. The features of this disease, for example, I think may be wholly accounted for, consistently with the physiology of the insect, as results of the simple destruction of the epithelium of the cœca and the consequent suppression of the functions of those organs, combined with the toxic effects of the products of bacterial action.

Is it not quite possible that the student of pathology may find in the study of the diseases of these lower forms of life experiments prepared for him by Nature which it would be quite impossible for him to imitate on animals of more complicated sensitive and sympathetic organization, and that he may thus sometimes simplify a problem whose complexity must otherwise prevent its solution ?—*N. Am. Practitioner.*

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The American Postal Microscopical Club announces that arrangements for the resumption of the circulation of its boxes are now progressing. It is desired that changes of address and other business relating to the membership or organization of circuits be at once reported to Dr. Ward, the resident manager, at 53 Fourth street, Troy, N. Y. And a more strict conformity to all the rules of the Club than has characterized the past is bespoken for the coming year. The work circulated this year will doubtless be of an improved character, since not only have the poorer of the slides circulated last season been withdrawn, but the special series of slides contributed by members in response to last year's call have been reënforced by a considerable supply of fine foreign work purchased abroad during the summer.

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Notice.—Messrs. J. W. Queen & Co., of Philadelphia, oculists and opticians, and manufacturers of scientific instruments, have transferred their entire plant, formerly located at 924 Chestnut street, to the larger building, 1010 Chestnut street.

Adjunct Organs to Spiracles.

By EDWARD GRAY, M. D.,

BENICIA, CALIFORNIA.

Upon a slide of a "potato worm" which has very lately been added to my collection there are some curious and remarkable structures of which little notice has thus far been taken; at any rate, the only account of anything similar known to me is contained in *Science Gossip* of last year. These two structures are in the vicinity of the spiracle, and the smaller is in intimate relation with it. The spiracle itself has a double opening of long elliptical shape; the border, strongly marked by its color, has transverse markings something like the diatom cocconema. Lying against the broader end is a structure resembling the halter of a blowfly. As shown upon the slide mentioned, which is an ordinary balsam mount, it consists of a spheroidal sac, the walls of which are thrown into a few faint, shallow folds away from the spiracle, and connected with this a curved tube ending in a trumpet or funnel-shaped oval opening traversed by several digitate lines. This terminal expansion has but slight color and is perfectly transparent, as is also the globular sac at its commencement. The slide does not show what relation any portion of this structure may have to the trachea. This is unfortunate for the sake of clear description. The stalked organ written of in *Science Gossip* is presumably of similar nature, but certainly different in shape and anatomical arrangement.

Now, what is this organ? Standing in intimate relation with the spiracle it must have something to do with vibrations of the air, or as a reservoir of some character. Whether it is a sound-producing organ or a sound-registering apparatus, or neither, and connected with some other sense, remains to be seen. In the object no trace of nerves is to be found; but that is doubtless due to the method of preparation employed. Had, for example, this larva been mounted fresh in Thwaite's fluid it would be practicable to determine with some approach to accuracy many points now unattainable. The structure is such that it unavoidably reminds one of the ear; and they may be organs of hearing. It can by no means be held as conclusive against this view that auditory organs of several pairs in this region are not yet known. Before it became known that certain Orthoptera carry tympana in their forelegs, any one suggesting the possibility of such an event would surely have been ridiculed. It is not overlooked that these organs may belong to a sense in the insect of which we have no knowledge. Here the lack of like preparations and even the knowledge of the name of the creature which furnished this noteworthy slide bars the writer from instituting a searching investigation of this structure. It might be supposed that the sac originally contained otoliths, a few bodies looking like such remaining upon the slide after all the handling.

The other structure is far more evident and less complex. It is upon, or in, the chitine, and is a rather large and broad shield, shaped like the half of a pear, bearing ten to thirteen transverse bands of dark color, alternating with light stripes and with a row of dots in the centre of the band (the former seat of hairs?). These occur in pairs upon each segment of the abdomen, and very near the organs before described. It is plain that the occurrence of these two peculiarities in the same crea-

ture make it very individual. Can any reader inform me what the object described really is, and how to obtain specimens the coming spring? This larva was found in a potato in Illinois.

As to the physiology of these last-mentioned bodies there is assumed to be none, except as marks distinguishing the species.

The adult is believed to be a beetle of the tribe Elateridæ, but this is not an established fact.

The attention of microscopists, and particularly entomologists, is invited to the subject here so imperfectly presented.

A Course in Microscopical Technology for Colleges of Pharmacy.

By Dr. H. M. WHELPLEY, F. R. M. S.,

ST. LOUIS, MO.

The past few years have witnessed an appreciable growth in the use of the microscope in drug stores. The colleges of pharmacy have not been slow to realize the situation, for we find that microscopy constitutes a part of the curriculum in nearly all of the teaching colleges of pharmacy. Judging from the information given in the various annual catalogues, there exists quite a diversity of plans for instructing pharmaceutical students in the use of the microscope. The following outline is given, not as the only serviceable plan, but as one which has proven of value in the past. Like all systems for education in special branches of study, it is not perfect, and I hope that discussion may follow this paper and result in adding to the efficiency of the plan. I believe that the instructions in microscopy at a college of pharmacy should not be confined to strictly pharmaceutical microscopy, but should give such information as will enable the student to manipulate the instrument in any other vocation of life.

In order to base the knowledge of microscopy on a solid scientific foundation, it is essential that the students have an understanding of the principles of optics that apply to microscopy. A special lecture on this subject, illustrated with black-board drawings or stereopticon views, is far more valuable than book study. In fact, I find but little use for text-books in teaching microscopy.

Following the lecture on optics should come one of practice with the simple microscope. This will initiate the students into the mysteries of magnified objects, and teach them to appreciate the relation between objects as seen by aid of the naked eye and those that are magnified. Several kinds of simple microscopes should be used.

Next comes the compound microscope. As a physician studies the anatomy and physiology of the human body, so should the student be taught the anatomy and physiology of the microscope. The stand, with a consideration of its various parts, is first in order. Then follows the optical apparatus.

It is essential to teach the students how to sit at the table, and how to place the instrument so that the most work can be accomplished with the least discomfort. Habits must be formed early in the practice.

Only low powers are suitable for the first lessons. The use of transmitted light can be followed by reflected light.

Never give the students very small or unfamiliar objects until they

have complete control of the instrument, and realize the relation of object and image. This is the time to teach the desirability of examining objects by both reflected and transmitted light.

The measuring of magnified objects is next in order. This serves to fix the real value of an instrument on the minds of the beginners, and I find that they appreciate it. First measure familiar and large objects, and then follow with less familiar and smaller ones.

By this time students will be ready to determine the magnifying powers of both simple and compound instruments. See to it that they learn the principle and make free use of it. Every student who has an instrument of his own should be permitted to bring it to the class, and determine the value of the various combinations, as well as taught how to record them.

The use of the camera lucida and drawing naturally follows at this point and should be given attention. A review of all that has been studied is appropriate, and will determine whether the students are ready for the next step.

The mounting of objects will have excited the curiosity of students by this time, and they will be ready to give it close attention. Commence with the very simplest forms of dry mounts, and then step to the use of liquid media, and finally the use of " balsam " and other resins. The mounting of crystals and other objects which require special manipulation can follow the simple work.

Section cutting and the preparation of specimens of various kinds will next interest the student. Here special attention and practice should be confined to pharmacy, but reference can be made to work in animal histology and pathology.

It will be observed that the above outline of study is not in the order that a person will follow when working at home. The microscopist will cut sections, prepare and mount the specimens, and then measure and otherwise study them. It is from experience that I have concluded that a different order is better for instructions.

It is not my purpose to outline a course in the application of microscopy to pharmacy, such as the study of vegetable histology, the detection of adulterations, etc. In such work text-books and collateral instructions are serviceable. The subject is one worthy of a special paper.

The proper care of the microscope should be insisted upon in the class-room, so that the students will not neglect it at home.

Towards the close of the course is the proper time to impress the students with the importance of forming collections of such specimens as are of use in work or entertaining when exhibited. I always feel as if the microscopist who never makes permanent mounts is like a person who does not preserve books for reference after having read them. Both books and permanent mounts are of use to others.

Pharmacy students scatter to all parts of the country, and can do a good work in the interest of microscopy if they form local organizations where even two or more workers are found. Competent physicians are ever ready to join, so that the druggist and doctor can meet on a common ground and instruct each other in the application of microscopy to their respective vocations.

The low price of microscopes at the present time enables any druggist to own one, so that students should be urged to make the instru-

ment one of the requisites for a well-kept store, and use it as often as possible. Local societies assist in this direction. While the microscope is a necessary instrument for the use of the educated pharmacist, it is also serviceable for amusement. The pestle and mortar should not leave the laboratory, but the microscope will grace the home and entertain a drawing-room of visitors. Teachers can point this out during the course of instructions, and occasionally use specimens suitable for such occasions as social gatherings.

The course of instructions must not be closed without reference to the literature of microscopy. Each teacher will have individual ideas as to books and periodicals, but all must agree that it is desirable to keep posted on current topics, and each owner of a microscope should take one or more periodicals.

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A Costly Microscope.—Among the exhibits at the World's Fair will be a microscope made by a Munich firm at a cost of $8,750. Electricity furnishes and regulates the source of light, which, placed in the focus of a parabolic aluminum reflector, reaches an intensity of 11,000 candle power. There is an automatic mechanism, worked by electricity, for the centering of the quadruple condensers and illuminating the lenses, and there is also an arrangement for the exact control of the distance of the carbon point. The instrument is provided with an elaborate cooling machine, which is rendered necessary by the extreme heat generated by the illuminating arrangement. The magnifying power of the apparatus with ordinary objectives is about 11,000 diameters, but with the oil immersion this can be increased to 16,000.—*British Med. Jour.*

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Photographing in Colors.—The method by which Mr. Frederick E. Ives, of Philadelphia, has solved the problem of photography in colors is something as follows: Three negatives are made from the same point of view on ordinary orthochromatic dry plates, one by means of the red light rays, one by the blue, and one by the green. From these negatives positives are made, which are projected upon a screen, the three images being superimposed. The light passing through each of these positives is colored by suitably tinted glasses, corresponding to the light rays used in securing the negatives. The resulting image on the screen appears in the colors of the original.

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Luminosity of Plants.—In *Science Gossip* for September, 1891, Canon Russell records the observation of phosphorescence in the flowers and leaves of the marigold, the nasturtium, and the geranium. The phenomenon is observable in the dark by the naked eye, but becomes much more evident when a leaf is placed under the microscope, when the leaf can be seen by its own light.

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Sea-Nettles.—During the autumn the salt water teems with irritating swarms of *Medusidæ*. Sometimes the stinging filaments contained in the thread-cells of these animals prove very unpleasant to bathers. Recently a bather who came in contact with sea-jelly was obliged to send for medical assistance to obtain relief from the smarting produced. As a rule, those *Medusæ* which are uniformly bluish-white in color are inert, while those of smaller size and with reddish-brown tentacula possess well-marked irritant properties.—*Lancet.*

Microscopical Notes From Europe.—I.

By CHARLES W. SMILEY,

WASHINGTON, D. C.

During our recent stay in London we paid a visit to the store of W. Watson & Sons, at 313 High Holborn, and were surprised to find the immense trade this firm is doing in microscopes and apparatus, cameras and other optical goods. We were afforded an opportunity of inspecting the various workshops and seeing the goods in course of manufacture. We had expected to have to go to Germany to see the manufacture of optical instruments on such a large scale. Although we were aware that Messrs. Watson & Sons had large workshops, our anticipations of their size and of the number of hands employed did not rise to the actual magnitude. Their factories at 9, 10, and 11 Fulwood's Rents, Holborn, occupy an area of 6,000 square feet, the 4 floors giving an area of about 24,000 square feet. Here we saw machinery of the most ingenious description, in many instances devised specially by the firm for the work, running by steam-power, including moulding and sawing machines, planing machines, drilling machines, a large press, etc., etc. Here also we saw photographic lenses being mounted and centered, and every description of brass work for both optical instruments and cameras in course of making and finishing. On other floors we witnessed the French polishing of cameras and the whole process of making these instruments for which Messrs. Watson are noted throughout the world. We then went to the workshops over the store, where the microscopes are fixed up, and we saw in course of manufacture the different forms of Edinburgh Student's microscopes, the new Van Heurck microscope for photo-micrography and high power—their largest size, No. 1, swinging substage microscope; and having seen the care, order, and method adopted in every detail, we do not wonder that their work is so much appreciated. We then went into the glass-grinding shop and saw there being worked objectives varying in power from 1 in., to 1-12th in.; also photographic lenses of all sizes. We also saw the system adopted of testing for centrality of the lenses composing an object-glass, it being, of course, absolutely necessary that the axes of all the lenses shall be exactly coincident. We then, with one of the Edinburgh Student's microscopes, had a look through some finished objectives, and must say they require a lot of beating, while for price they are far cheaper than any obtainable in America. Notwithstanding all the facilities that Messrs. Watson have, the demand for their goods is so great that they have had to build specially for their work an additional factory, Nos. 16 and 17 Fulwood's Rents, which is nearly ready for occupation, and which will permit of their employing nearly double the number of hands (at present considerably over 100), when they hope to be able to fill their orders directly after they are received. There appears to be any amount of energy in this firm, and we feel safe in prophesying a big future for it. We advise all our readers to get their catalogues of instruments and microscopic objects (which we are informed will be mailed free), and see for themselves the variety of patterns of microscopes they make, all of which are of beautiful workmanship, and as they advertise them, "perfect in every detail."

PARIS, *August* 3, 1891.

The Living Earth.

By George Vivan Poore.

[*Abstract.*]

It is plain that all excretion and waste matter should be returned to the earth from which they came, instead of being cast into the river and sea, as in our present way of disposing of the garbage of our large cities. We know that the mould which forms the upper stratum of the ground upon which we live is composed of organic matter and is teeming with life. This black vegetable mould is largely made up of excrement due, in great part, to the unwearying labors of the earthworm, probably the most important of all the animals inhabiting the soil.

While the amount of animal life is considerable, it is nothing in comparison with the richness of the soil in the lower forms of vegetable life, as the saphrophytic fungi. By means of these micro-organisms and others of the same class, oxidation or even reduction is caused in organic matter. The vitrifying process may be produced by the bacillococcus of Frankland, but lately discovered, alone or to other microbes not as yet isolated. This mould should form a filter of the most perfect kind, as is shown by the fact that vegetable life tends to greatly diminish as we go down towards the deeper layers. The tenacity with which the mould retains water is due to the fact that millions of these vegetable cells absorb the moisture into their interior, and, becoming swollen, form an effectual barrier to the passage of bacteria. The question whether or not the bacteria hurtful to mankind are found in the soil is of the greatest importance. As elsewhere, the survival of the fittest holds good, and organisms which flourish in the human body languish and cease to multiply in the soil, which supplies conditions unsuitable for their multiplication or even survival. The coma bacillus of Koch has been much studied, yet it must still be considered as an open question whether or not this microbe is the cause of cholera. As easily as cultures of this bacillus are prepared, they die when spread upon glass and exposed to the ordinary temperature, hence it is inferred that the transport of living coma bacillus, as in dust, through the air, is impossible. If the coma bacillus come in contact with the saphrophytes, they are soon overcome either by their nutrient material being used up, or by the production of poisonous products. Multiplication also probably never occurs in pure running water, while they may increase in bilge-water, or ever in the water of harbors. The best way, therefore, to get rid of the coma bacillus, as in injecta, is to dry them and expose the dried mass with the saphrophytes. Now, if the dejecta of a patient suffering from cholera be mixed with water and be taken by means of an impermeable pipe through the surface to a mineral subsurface where there is no sun to dry or saphrophytes to destroy the microbe, the danger of their getting into our drinking water is great. This living mould of the surface and dead earth of the subsoil have not been sufficiently well distinguished between. Our only efficient scavenger is in the living mould, which should be kept in a healthy condition by means of an early return to the soil of all organic matter. If these facts are applied to the prevention of the pollution of our water supply, it will be seen that while the present panacea for all sanitary

ills has been drainage and dilution, we but increase, rather than diminish, the danger of infection through excreta. The mixing of excremental matter with water is one common factor for all the outbreaks of typhoid fever in the statistics prepared by F. W. Willis for the writer. Typhoid is stated not to have been recognized in this country until the invention of the water-closet. The dangers which result from the putrefaction of a mixture of excretion and water in a sewer and cesspool are so great that the following reasons are given for keeping the excremental matters from the sewers:

1. Excrement is the only ingredient of sewage against which dangerous infectious properties have been proved again and again.

2. The old practice of leaving our household slops to run in open gutters could be revived in the country, and the gutters might be subject to the wholesome discipline of the broom and the purifying influences of sunlight and drying winds.

3. The volume of sewage would be diminished at least one-fifth. The manurial value of human excrement thus saved would be enormous. The composition of the average sewage is so variable, and is so often nowadays filled with antiseptics, that its value as a fertilizer is often on the minus instead of the plus side.

It is the writer's firm conviction after a practical experience of nine years that the disposal of the sewage in the way and manner about to be described is so desirable from every point of view, scientific, sanitary, moral, and economical, that he cannot too strongly impress upon the dweller in the country that he should be warned by the towns and revert to the cleanly and decent habits of our forefathers, and keep the sanitary offices away from the main structure of the house. We advise all solid matter to be kept out of the house-drains by means of a strainer, and to have them decently buried each day in the living earth. Drains are replaced by gutters, and the household slops are filtered and applied to the top of a different piece of cultivated land every day. Even in the city the accumulation of fæcal matter is taken to the country and directly applied to the soil. We are told by Acland that the disappearance of the great cities of antiquity was due rather to pestilence than to war. In this respect the Chinese should be studied; they were a great nation in the time of Moses, and have seen many people come and go, and if we do not mend our ways they will see us go out as a nation. In China nothing is wasted; all organic refuse is ultimately returned to the soil. While we should not follow them in many of their filthy habits, in this we should learn a lesson. A nation that fouls its streams and starves its soil is in danger of poisoning and inanition, and a nation which imports a great part of its food and a great part of its manure, and systematically and by act of parliament throws all its organic refuse into the sea, is undoubtedly living upon its capital. Our capital just now is considerable, but we are in a fair way to run through it, and when we have done so who can predict the future?—*Transactions of the Sanitary Institute, vol. XI, Congress at Brighton, 1890.*

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Slides Received.—Our thanks to Mr. George Rust for some fine slides of fossil Diatomaceæ of Denver, Colorado, just received.

TECHNIQUE.

Staining Bacillus of Glanders.—Herr E. Noniewicz advises a combination of Löffler's and Unna's methods for staining *B. mallei*. The procedure, which is stated to give excellent results, is as follows: The sections are transferred from alcohol to Löffler's methylen-blue solution (caustic potash 1 : 10.000). They are then washed in distilled water and placed in the decolorizing fluid (75 parts ½ per cent. acetic acid and 25 parts ½ per cent. watery tropæolin O O). The time for decolorizing depends on the thickness of the sections, the thick ones requiring from 2 to 5 seconds, the thin ones much less. The preparations are then thoroughly washed in distilled water; this removes the acetic acid and a good deal of the stain. The sections are then put on a slide, and the water having been removed with blotting-paper, are dried in the air or over a spirit-lamp. Xylol is then dropped on and allowed to remain till the section is quite clear. They may now be examined or mounted in balsam. Oil of cloves, origanum oil, and anilin oil are not to be used. In this way the glanders bacilli are stained almost black, while the tissue is bluish.—*Deutsch Zeitschr., f. Thiermed. u. Vergleich, Pathol.*

Staining Pathogenic Fungus of Malaria.—Surgeon J. Fenton Evans has found it possible to stain the organisms of malaria with an anilized alkalized solution of rosanilin hydrochloride after treatment with bichromate of potash, and after treatment with dilute sulphuric acid by an anilinized alkalized solution of Weigert's acid fuchsin. Another method is the saturation of the tissue with a copper salt, and its reduction by sulphuretted hydrogen previous to coloration with anilinized alkalized acid fuchsin.—*Proc. Royal Soc. London, 1891.*

Characteristics of Some Anilin Dyes—Dr. C. Vinassa, in a contribution to "Pharmacognostic Microscopy," published in *Zeitschr. f. Wiss. Mikr., viii, p. 34–50, 1891*, communicates the result of a number of experiments made with fifty-one different anilin pigments. These results are displayed in two tables. In the first are noticed the behavior to acids and alkalies, and the stain imparted to the microscopical preparation. Some of the dyes showed a capacity for double staining, the most notable of these being "Solidgrün" and "Deltapurpurin." By these the vessels were stained green and the parenchyma red.

Many other useful staining qualities and characteristics may be gathered from a perusal of the table, but for these the original must be consulted. Table 2 gives the chemical derivation, the peculiar microscopical stainings of the various tissue-elements, and the behavior as dyes to certain commercial products, such as silk, wool, etc.

Method of Observing Pectinatella Gelatinosa.—Mr. A. Oka states that this polyzoon is remarkable for the ease with which it can be killed in an expanded condition. When 70 per cent. alcohol is gradually poured into a vessel containing the colonies, more than half the polypides die protruded. With such reagents as chloral hydrate or cocain chloro-hydrate every polypide dies expanded. Some colonies were fixed with a saturated solution of corrosive sublimate or a weak

(0.1 per cent.) solution of chromic acid. Borax-carmine and picro-carmine were chiefly used for staining. Sometimes a whole colony was imbedded.

The development of the polypide within the statoblast was thus studied: a statoblast was hardened in alcohol, and its edge was then cut between two pieces of elder-pith so as to make an opening in the chitinous shell; it was then stained and kept in alcohol until cut. In cutting the statoblast celloidin was indispensable, owing to the hardness of the shell. Fresh specimens were put on a slide after stupefying with cocain. The habits of the colonies may be studied by keeping them in vessels through which water is always flowing.—*Jour. Coll. of Sci. Imper. Univ. Japan, 1891.*

Remarks on a new method (Interlamellar Films) of studying the Development of Micro-Organisms and the Mutability of their Characters and Properties—Sheridan-Delépine considers the simplest way of solving the vexed question of the constancy or of the mutability of pathogenic bacteria to be in the isolation of one spore, and the following of its development through all its stages and in different media. Having failed by the dilution method of Brefeld and by the plate and drop cultivation to obtain the desired results, the author was led to adopt a new mode of cultivation, which, while by no means perfect, has yielded some satisfactory results. The principle of the method is to inclose a thin layer of the nutrient medium between two parallel plates, so as to force the organism to grow in definite directions. If evaporation be prevented, the effects of capillarity are such that the most fluid media becomes fixed and can be used. At each end of a glass slide ($1\frac{1}{2}$ in. by 3 in.) a narrow strip of glass is fixed so that the slides can be piled one upon the other in the incubator, or inverted on a sterilized plate. Upon the upper surface of the heated slide three small drops of sealing-wax are dropped. These drops are used to support a cover-glass an inch and a quarter in diameter at a certain distance above the slide. The slide being sterilized, a drop of nutrient fluid is placed upon it, and the slide inverted or placed under a thoroughly sterilized plate. The cover-glass is then sterilized, and the surface which is to be next to the slide is carefully protected from the access of any germ or dust. On this surface a very small drop of sterilized material is placed, and this drop is touched with a wire charged with a few organisms. A number of cover-glasses are thus prepared and examined with a pretty high power, the inoculated surface being placed downwards. When a slide is found containing the number or kind of organism desired, it is gently placed over the drop of nutrient material on the slide. A heated rod is then applied successively over the three drops of sealing-wax until the inoculated fluid has spread evenly and to the thickness required. The slides are then transferred to a moist chamber in an incubator. Slides thus prepared can be studied at pleasure. Delépine has followed the development of bacteria and spores of pathogenic pyrenomycetes for days and weeks. By this interlamellar method the branching of the schizomycetes, and even the formation of oxalic acid out of gelatine, starch, gum-arabic, and possibly cellulose, can be demonstrated. The formation of oxalic acid only begins when growing filaments have free access to air. Further details regarding the modifications which have been suggested by circumstances and the

genera nature of the results obtained are promised in a future paper.—
The Lancet, June 13, 1891.

Examining for Spermatozoids.—In examining for spermatozoids, do not try to wash the semen from the clothing which it stains. In the case of thin, translucent cloth place the cloth itself directly under the objective, moistening it by a drop of water placed on the slide. If the garment be of heavy or dark-colored cloth, examine ravelled threads moistened in water.

Circulation in Spiders.—Prepare a slide by smearing a part with Canada balsam. Then catch a spider and fasten his legs in the balsam, well spread out. Each one shows the circulation admirably.—*Int. Jour. of Microscopy.*

Ringworm of Domestic Animals.—From Bulletin No. 16 of the *Agricultural Experiment Station* at Fayetteville, Ark., we abstract the following facts in regard to the disease known in the Western States as "white scab:"

Although symptoms differ somewhat in men and animals, the disease is the same as ringworm in man, and is caused by the same parasite, viz: *Trichophyton tonsurans.*

The parasite can be seen by soaking some of the scales scraped from the diseased parts in moderately strong solution of potash for about twelve hours, and examining the same with a magnification of 100 diameters or more. The scurfy mass is composed of epidermal scales, parts of broken and entangled hairs, and fungus threads and spores. The fungus elements are found in great abundance in the hairs and surrounding them. The relation of the fungus to the hairs can be best demonstrated in the short hairs which have been pulled out by the roots after removal of the superficial scabby mass from a diseased patch.

The cells of the root sheath, which may come out with the hair, are not usually affected, but masses of *conidia* may be seen surrounding the hair above the beginning of the attached cells of the sheath. These cells or spores are thickly grouped together, without any evident linear arrangement. They are, for the most part, spherical. At the outer edge, where the mass is thinner, a few filaments, more or less segmented, as well as spores arranged in linear series, can be seen. In the hairs, running chiefly in the direction of the hair fibres, are long rows of the same cells which penetrate in the substance of the hair down to a point lower than the beginning of the sheath and lower than they are seen on the outside of the hair. The string of vegetable cells may reach to the bulb of the hair, but it is not usual to find them extending quite to the extremity.

In the hair we find: (1) Cells resembling those around it, spherical in shape and not distinctly in rows; these are not numerous. (2) Rows of cells, of considerable length, running in the direction of the long axis of the hair. These cells or spores are closely apposed to each other, and are not spherical but quadrangular in shape. (3) In places we recognize filaments or threads of the same thickness as these chains, or in some cases less, in which no segmentation can be noticed.

In the scales we find the same elements, but filaments are here more common and the fungus is always most abundant in the neighborhood

of entangled hair. Many such hairs or parts of hairs seem to be a solid mass of fungus spores.

In size the spores average, when in chains, as they are usually to be found in the hair, 3.5 micromm.; the filaments average about 3 micromm. in width. The filaments may show scattered granules, but vacuoles are not seen, and branching is not very frequent. Short, abortive branchlets are not uncommon. The size of the fungus elements (spores and mycelial threads) does not appreciably vary in cattle and horses.

In human pathology this parasite, by its growth in the skin, gives rise to various forms of disease, all included under the common designation of "ringworm," the differences being due to the various positions in which the parasite is found. The affection in young cattle corresponds to ringworm of the scalp in children (*Tinea tonsurans*), and the fungus thus described seems to be identical with the *Trichophyton tonsurans*.

Botanists have, for the most part, been reluctant to recognize this fungus otherwise than as a modification of some common mould; but the researches of Grawitz, Quincke, and others by aid of modern bacteriological methods seem to prove it a distinct species. It is placed with the *Odium lactis*, intermediate between the true moulds and the sprouting fungi or yeasts. Grawitz has shown that it is the immediate cause of ringworm. However, there is always very manifestly, in cattle at least, a certain condition of the skin necessary for its growth.

In testing the contagiousness of bovine form of ringworm, it was found that scales taken from a diseased patch and rubbed dry on another animal, or on another part of the same animal, seldom produced infection. If, on the other hand, the infectious material was well soaked in water, and then applied, the disease was almost certainly reproduced, and it was not necessary to cut or abrade the surface where the spores were applied. This was in winter and early spring. Later, when the cattle obtained an abundant supply of good pasture, it was impossible to produce artificial infection, and animals already infected recovered spontaneously, with complete return of hair, and without any trace of the disease remaining. No doubt the vernal shedding of the hair largely contributes to the removal of the fungus from the skin.

Action of Cold on the Virus of Rabies.—A rabbit which had died of rabies was immediately placed in a chamber, the temperature of which ranged from 10° to 27° below zero C. After having been frozen for six months, the spinal marrow of the animal was removed, and inoculations from it were made upon a healthy rabbit. After two weeks time, the inoculated animal presented symptoms of hydrophobia and died two days later.—*Le Bull. Med.*

Cycle of Tænia Coronula.—In the *Internat. Jour. Micros. & Nat. Sci.* for October, 1891, T. B. Rosseter records observations that seem to determine the life cycle of *Tænia coronula*, Dujardin. The host of the adult tape-worm is the duck. The ripe proglottides, being expelled from the duck, burst and set free the eggs, which develop into minute worms. These, entering within the shell of *Cypris cinerea*, become encysted, and develop into what has been known as the *Cysticercus of Cypris cinerea*. The duck swallows the Cypris, and within the viscera of the duck the *Cysticerci* become mature tape-worms.

BACTERIOLOGY.

Bacteriology of Yellow Fever.—Domingo-Freire has described the *Cryptococcus xantogenius*, which is round and has a diameter of one-thousandth of a millimetre. This micro-organism is only found in the tropics. Quite often the cryptococcus is arranged in little chains. In cultures it gives rise to yellow and black pigments. The former is soluble, and stains the skin of patients with yellow fever; the latter gives color to the vomited matter. When the blood of yellow-fever patients or a culture of the microbes is injected into guinea-pigs, yellow fever is produced. The ptomaines only produce certain symptoms. Transplantation attenuates the cultures, and it is possible to protect the human system from the malady. Inoculation produces a group of phenomena similar to those of the invasion of yellow fever. In forty-eight hours the symptoms have disappeared. Sometimes icterus is produced. Domingo-Freire has made a large number of inoculations. The average mortality of inoculated subjects is four-tenths of one per cent.—*L'Union Méd.*, Sept. 5, 1891. Abstracted in *The Satellite*.

The Klebs-Loeffler Bacillus.—It will be remembered that in many cases of disease diagnosticated as diphtheria, Prudden failed to find the characteristic Klebs-Loeffler bacillus, while European observers, as a rule, find it. The reason assigned for this discrepancy of results is that American physicians often confound diphtheria with simple anginas. Welch and Abbot, of Johns Hopkins, examining eight cases of uncomplicated diphtheria, found the bacillus in every case. They consider that "the endless controversy as to whether diphtheria is primarily a local or a general disease is settled in favor of the doctrine that it is primarily local, and that the grave constitutional symptoms are the result of intoxication with poisonous products, formed by the local action of the bacilli."

The Bacillus of Syphilis.—Marschalkó read a paper on this subject at a meeting of the Medical Society of Buda-Pesth, April 11, 1891. The author has discovered a method much simpler than that of Lustgarten, by which the presence of bacilli may be detected in sections of syphilitic tissue. The method is as follows: Stain in concentrated solution of methylin blue several hours; wash in distilled water; stain for one to five minutes in concentrated aqueous solution of vesuvin.—*Satellite, Oct., 1891.*

A New Bacillus.—Du Casal and Vilard, of the Institut Pasteur, report upon a new bacillary disease. The matter is of considerable interest, since the disease may be, and probably has been, confounded with tuberculosis, the abdominal lesions being somewhat similar. In the case reported, however, the course of the disease was much more rapid than that of tuberculosis. The bacillus has been isolated. It has the form of short, mobile rods, single, combined in pairs, or in chains. Inoculations were without effect upon guinea-pigs, but cultures were pathogenic to rabbits and mice.—*Public Health, Sept., 1891.*

Food of Bacteria.—Among the advantages of filtering water, it is to be remembered that, even if filtration does not actually diminish the number of germs in the water, it removes a large proportion of the organic matter on which the germs depend for food.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,
WASHINGTON, D. C.

Koch's Lymph.—The Brooklyn *Medical Journal* for November contains an article by Oscar Embden, M. D., entitled "The Wrong and the Right Use of Dr. Koch's Lymph." In Dr. Embden's opinion, the lymph will yet prove a most valuable remedial agent. He points out some of the reasons why it has temporarily fallen into disrepute; such as that it has been used in hopeless cases, and often without the needful adjuvant treatment. With regard to operations upon lung cavities, he lays stress upon the fact, which has often been insisted upon in this journal, that it is almost impossible to locate a small cavity accurately. In tuberculosis of bones and joints, and in lupus, the lymph injections should be preceded by thorough and energetic surgical measures. When this course is pursued, the lymph materially hastens the cure. Another serious mistake has been the employment of too large doses.

The Sense of Taste in the Larynx.—It has long been known to histologists that the specific end-organs of taste, namely, the taste-bulbs, occur on the inner surface of the epiglottis. Recent experiments by Michelson furnish the physiological proof that the sense of taste is actually possessed by the epiglottis.—*Abstract in Am. Pract. ana News, Oct. 10, 1891.*

EDITORIAL.

All Facts are Valuable.—Probably the annihilation of the diatom would result in palpable and important changes in the solar system. Perhaps it would require some time to demonstrate this proposition, but it is simply another way of saying that little things are of consequence. Probably every worker in science at times feels like throwing down his tools and crying, "What is the use? I can contribute only an atom to the sum of the word's knowledge."

Pick up your forceps and scalpel. It is just that atom that the world wants from you. The structure of our modern cosmos is so intricate that no man can trace all the interdependencies in a given case. You may have made only one original discovery in the year; but that one new bit of knowledge may revolutionize the policy of nations within a decade. Every fact is wheat, and the only chaff is untruth. Therefore study, observe, record.

MICROSCOPICAL SOCIETIES.

Microscopical Society of Washington.—At the annual meeting of the Microscopical Society of Washington, the following board of officers was elected: President, Dr. J. Melvin Lamb; Vice-President, Dr. V. A. Moore; Recording Secretary, Mr. L. M. Mooers; Corresponding Secretary, Dr. W. W. Alleger; Treasurer, Mr. J. M. Yznaga; Curator, Dr. W. H. Seaman. About fifteen members were

present. Dr. Lamb read a paper on Fixatives, which was discussed by Dr. Penrose, Dr. Taylor, and Dr. Alleger. The Society has forty-six active members and four corresponding members. Hereafter the regular meetings will be held on the first and third Tuesdays of each month. The Society is arranging for the purchase of a first-class microscope.

The Microscopical Society of Calcutta held its monthly meeting September 14, 1891, J. Wood Mason, Esq., the President, presiding.

Mr. W. J. Simmons read a paper on "Some of the Animal and Vegetable Micro-Organisms procurable in the General's tank, Calcutta." From this tank he had taken eleven different algæ, one (*Zygnema*) being quite rare, seven different desmids, eight diatoms, twenty-one infusoriæ, and six rhizopods. Of one of these he obtained five different species; of others, three and four.

In deposits and decaying leaves he found five different worms and various fungi, ova, and spores.

NOTICES OF BOOKS.

Pantobiblion is an *International Bibliographical Review* of the world's scientific literature, published monthly. The purpose of this journal is to enable literary and scientific men to be promptly and correctly informed of all current scientific literature. It contains a list of all new books published in the different languages of the world, a series of critical articles on all the leading scientific publications, and reviews of current periodical literature. It is published in fifteen different languages, and is one of the most perfect reviews of its kind.

Mental Suggestion: By J. Ochorowicz, sometime Professor Extraordinarius of Psychology and Natural Philosophy in the University of Lemberg. Published by Humbolt Publishing Co., 19 Astor Place, New York, in four double numbers.

The author, being a learned physiologist and physicist as well as a psychologist, is in every way competent to treat the subject. It is a work original in its method and point of view, and possesses great charm of literary style, together with simplicity and clearness of expression. It is unquestionably the most complete work on hypnotism ever written.

NOTES.

To those interested in the Diatomaceæ we commend an article published in the November number of the *American Journal of Science*, by Arthur M. Edwards, M. D., entitled, "Report of the Examination by Means of the Microscope of Specimens of Infusorial Earths of the Pacific Coast of the United States." The trend of the paper is not to the determination of species, but to geological formation and the origin of deposits.

A class in Bacteriology was opened at Georgetown College on Nov. 5th.

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.]

WANTED.—A Bulloch Professional Stand. Address, stating price,—
HENRY C. WELLS, 151 Broadway, New York City.

WANTED.—Vol. VII, No. 2 (Feb , 1886), of American Monthly Microscopical Journal.
A. G. YOUNG, State House, Augusta, Me.

WANTED.—Diatom material from America, Australia, and Asia in exchange for fossil and recent material from Denmark.
CHR. MICHELSEN, 33 Nedergade, Odense, Denmark.

FOR EXCHANGE.—Slides of diatoms from peat bogs in Boston, Mass.
F. F. FORBES, Brookline, Mass.

WANTED TO PURCHASE.—Histological slides from normal tissues of mammals, prepared with a view to show the size of the "cells," in cases where the age of the animal-subject is definitely known, as bearing on the question of a supposed diminution in the size of cells in aging organisms, corresponding to a similar decrease, reported by Balbiani and Maupas in aged unicellular life. Address,
C. A. STEPHENS' LABORATORY, Norway Lake, Maine.

WANTED.—Diatomaceous material of good quality, fossil and recent. I offer diatom slides or photo-micrographs in exchange.
D. B. WARD, Poughkeepsie, N. Y.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts.
PROF. ORSON HOWARD, Salt Lake City, Utah.

WANTED.—Any works on Microscopy not already in my Library.
H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares. S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

FOR SALE OR EXCHANGE.—Mosquitoes, male and female. Price 75 cents each. Will exchange only for first-class mounts. E. W. SHARP, 2800 Richmond St., Philadelphia, Pa.

A $5 MICROSCOPE.—Made on proper scientific principles. Magnifies 100 diameters or 10,000 times. For other interesting articles send for list of Popular Scientific Specialties.
G. S. WOOLMAN, 116 Fulton St., New York.

SPECIAL BARGAIN in histological slides.
WM. N. BEGGS, M. D., 2207 Sidney St., St. Louis, Mo.

FOR SALE OR EXCHANGE.—Photo-micrographs of P. angulatum taken through Spencer's $\frac{1}{10}$ H. I., 2400 diameters. Also photo-micrographs of bacteria, diatoms, etc., 25 cents each. Will exchange for well-mounted slides. DR. J. E. BAKER, Wyoming, Ohio.

TO MICROSCOPISTS.—After July 1 the price of my well-known slides will be the uniform one of 50c. each, $5.00 per dozen. Send 2c. stamp for catalogue and 50c. for slide of Podura scales, test, or other diatoms, or of miscellaneous objects. Thum's "Oh, My!" slides of arranged diatoms, gorgeous butterfly scales, etc., at lowest rates.
M. A. BOOTH, F. R. M. S., Longmeadow, Mass.

FOR SALE.—Spencer's 1-in. 40° objective; first-class series; new; and Spencer's $\frac{1}{10}$-in. 113° B. A. homo. imm. Professional series; has been used, but is in perfect order. Reason for selling, bad health and failing eyesight.
THOS. H. URQUART, M. D., Hastings, Neb.

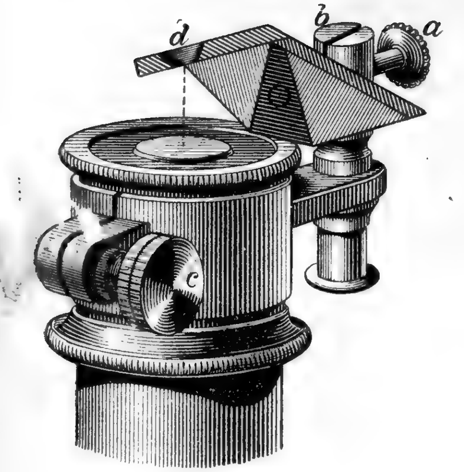

FIG. 1.

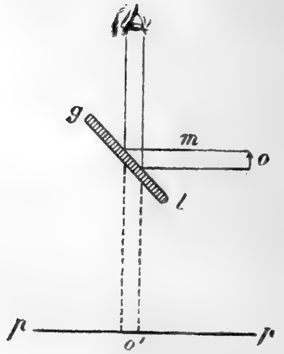

FIG. 2.

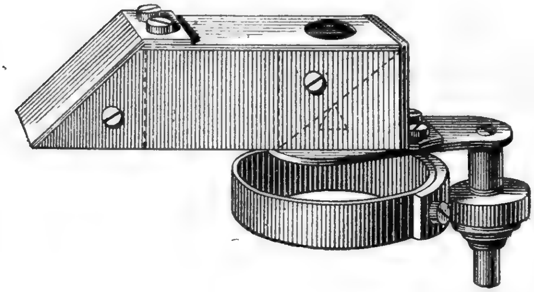

FIG. 4.

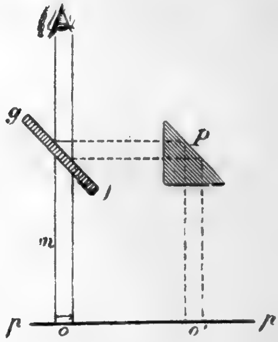

FIG. 3.

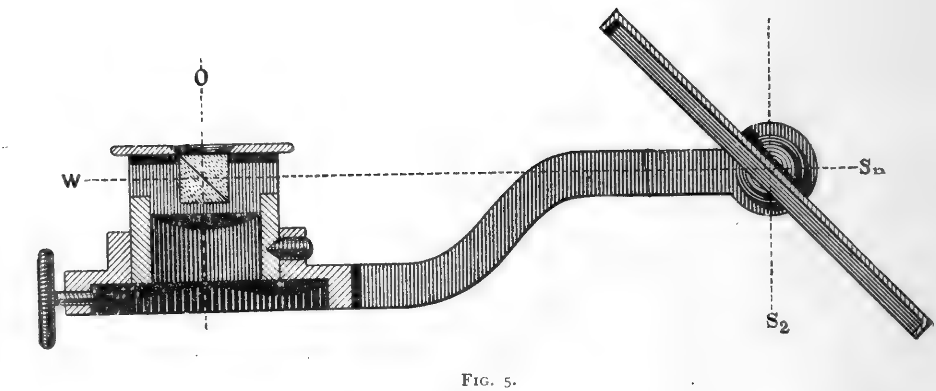

FIG. 5.

THE GRAPHO-PRISM.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. XII. **DECEMBER, 1891.** NO. 12.

All communications for this Journal, whether relating to business or to editorial matters, and all books, pamphlets, exchanges, etc., should be addressed to American Monthly Microscopical Journal, Washington, D. C.

European subscriptions may be sent directly to the above address accompanied by International Postal Order for $1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

The Grapho-Prism and its Use.

BY FREDERICK GAERTNER, M. D.,

PITTSBURGH, PA.

[With Frontispiece.]

To a practical microscopist who is not also a skilled artist perhaps nothing is more important among microscopical accessories than the camera lucida or grapho-prism. This prism is an instrument for sketching objects with the point of a pencil upon a piece of paper laid beside the microscope. By its use a high degree of accuracy may be attained. Perhaps the simplest and most successful drawing prism is that of Ziess (Fig. 1), which is followed by that of Nachet (Fig. 4), Abbe (Fig. 5), and Oberhauser (Fig. 6). Nobert's and many others work upon the same principles.

The following is an explanation of the principle of this drawing apparatus: If the glass plate *gl* (Fig. 2) stands at an angle of 45 degrees (45°) with the axis of the eye, the rays from the object *o* (which on their part also forms an angle of 45° with the glass plate) are reflected, and the picture of the object is seen in a position that also forms a right angle with that of the object. If *m* (Fig. 2) is the cylinder of the microscope and *pp* the piece of paper, in this case the eye will see upon the paper at *o′* the picture which is projected by the transparent condition of the glass plate *gl*. In this case we say that the picture is projected; but if we place a prism *p* (Fig. 3) upon the same level with the glass plate *gl* (Fig. 3), and *o* is the object under the microscope standing in a vertical position *m*, the glass *gl* forming an angle of 45° with the axis of the eye and standing upright over the ocular, we will then see the picture at *o′* upon *pp*. Meanwhile the projected picture of the object may also be seen in the horizon. Upon this basis rests the above-mentioned drawing prism of which Nachet's (Fig. 4) is the one most commonly in use in Europe after Ziess's. In this apparatus a prism is employed in place of the glass plate, while a second grapho-prism moves upon its own

axis so as to bring the reflecting surfaces at different angles. The purpose of a drawing prism is obvious as soon as it has been placed upon the ocular and adjusted.

Oberhauser's camera (Fig. 6) is somewhat more complicated than the others. For this reason I will give more in particular the details in regard to its practical application. The ascending rays from the objective are totally reflected through the large prism (*d*) into the horizontal arm (*A*). If the ocular is placed in a horizontal position (*B*) it directs the rays into the small prism (*C*) upon the figure of an angle of 45° if focused in the right position, where it is again reflected at a right angle into the observing eye.

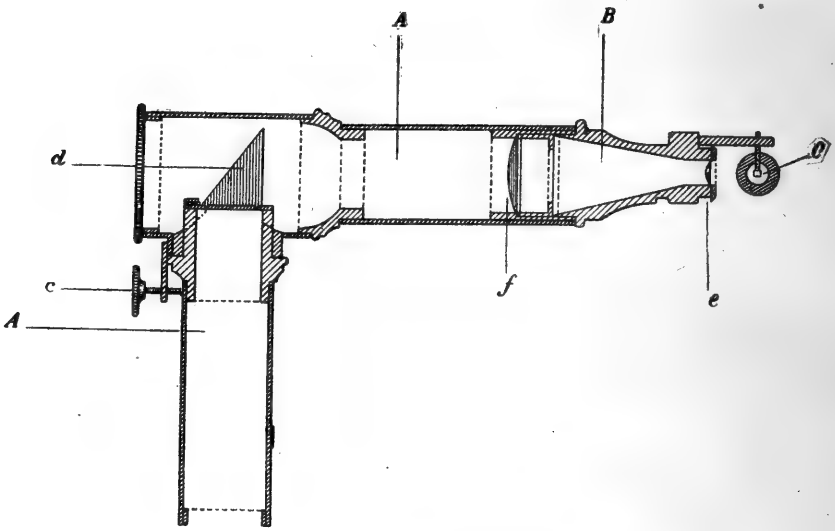

Fig. 6—Oberhauser's Grapho-prism.

Oberhauser's camera is very much liked for this reason: it does not create a disturbance nor a confusion by the reflection of the picture at a right angle upon the projected paper placed in a horizontal position. The Oberhauser camera is attached to the tube of the microscope at the ocular end without any trouble or loss of time. With but one exception this camera is perfect; it has a deficiency in one particular. When the microscopic picture is twice reflected it then loses considerable in accuracy, that is, in its clearness and exactness. This is especially so in the use of higher powers, oil immersions, etc. By the most concentrated light only can the special and superficial contour of the microscopic picture be best produced.

The practical and most applied drawing apparatus in microscopical work is the camera lucida. The object and the paper is seen with the one eye, and at the same time the picture is reflected into the eye by means of the mirror or prism. As the picture is seen upon the paper beside the microscope, its contour can be reproduced upon the paper with the point of a pencil, and that, too, with mathematical and scientific exactness; but he who has by practice learned to look into

the microscope with one eye and to hold the other eye open at the same time may get along even without the use of a camera lucida if he gazes with one eye into the microscope and with the other eye at a piece of paper lying beside the microscope. In a few moments the observer will find the object projected upon the paper and will thus be able to sketch the outlines with comparative ease and exactness.

In the execution of the drawing of the microscopic object it is best to use strong paper—bristol paper or bristol board, and the paper should be either pale yellow, pale green, or white, and slightly shaded. It is also advisable to have the paper fastened upon a smooth board. First use a soft and finely-sharpened black pencil, in order to secure the outlines and the contour of the picture. It should be slightly shaded without pressure. Then, with bread-crumbs, rub most of it out again. After that, with a heavy pencil retrace the outlines of the first drawing, again using the prism for comparison and exactness. This moment is the proper time to do the shading, if such is required, and this can easily be done with the point of a pencil and a rubber, or, still better, with charcoal and soft cloth. For drawing a picture with colors, water-colors are most commonly used; after them colored lead-pencils, oil-colors, and pastel crayon. I wish here to call especial attention to this fact, that in shading it is advisable to shade off the uncolored parts first with black; particular care must be taken that the shading does not extend into the colored field. It is also decidedly recommended to use a variety of colors, especially in the drawing of very minute objects such as endothelium and epithelium cells, fibrous and connective tissue cells, blood and lymphoid cells. In drawing a whole slide, or only a part of it, it is sometimes desirable to use a variety of colors. Not only will it make a drawing more elaborate, but decidedly more comprehensive and instructive.

Virchow, the most expert pathologist of the 19th century, has said that he would not give "ein pfennig" for illustrations, drawings, or sketches that were not correct and exact, because in every instance it would convey a false impression. Besides this, Virchow has said that all lectures, demonstrations, original articles of any kind, should be accompanied by first-class drawings or illlustrations.

I therefore would advise every practical and expert microscopist, especially microscopists that are not artists in drawing, sketching, and in the art of producing microscopic illustrations, to make use of the grapho-prism. Especially so would I advise students of practical histology, physiology, pathology, pathological anatomy, bacteriology, embryology, and pharmacology to use the grapho-prism hand in hand with the microscope. In studying a specimen under the microscope at the same time when one produces a drawing of the object which he is studying will certainly cause him to comprehend the subject more fully than he otherwise would.

"Disclaim," not "Disdain."—*The Observer*, quoting from our August number, makes Dr. Blanchard say that some of the microscopists of Washington are inclined to "disdain" the title of "microscopist." No, no, genial contemporary; not "disdain," but "disclaim." It makes a difference. By the way, the *Observer* is one of the most helpful journals for amateurs.

Microscopic Structure of Steel.

BY P. H. DUDLEY,

NEW YORK CITY.

[From Journal of the New York Microscopical Society, October, 1891.]

The subject is so vast and important that I shall confine my remarks principally to rail steel. Besides the iron forming the basis of ordinary steel rails, they have a large range in chemical composition, as shown by the following table:

	Parts of 1 per cent.
Carbon	.25 to .50
Manganese	.30 to 1.50
Silicon	.04 to .30
Phosphorus	.03 to .15
Sulphur	.04 to .10
Copper	.10 to .80

Traces of other minerals are present.

This alloy, being formed by fusion and cast, is, of course, crystalline in structure. The texture will be fine or coarse, according to composition, size of ingot, rapidity of solidification, amount of mechanical work given to the metal in reducing to the section of the rail, shape, and size of the latter, and the temperature at which the rail is finished. In a section of rail of which the ingot or bloom was maintained at too high temperature, the crystallization becomes coarse and often sharply defined, the matrix enclosing or joining the crystals weak and breaks upon the surface, instead of pulling out the portions which penetrated the large pseudo-crystals. The delicate matrix enclosing the pseudo-crystals is shown in specimen No. 1 with low powers, but few traces of lines from the matrix are seen to penetrate to the interior of the polygons. This specimen is from the tire of a steel wheel, is very hard, and contains 6 per cent. of manganese. Wheels of such steel have given a very large mileage. Specimen No. 2 is from a rejected heat of rails, and contains .90 of carbon. The ingot was maintained at too high a heat in the reheating furnace, coarse crystals resulting in the head of the rail, and, as will be seen, they are quite well defined. In the fracture the crystals have separated from each other through the matrix without breaking the individual crystals. This shows first the overheating of the steel, which, in a large head of a rail, does not receive sufficient work to break up this coarse crystallization. The distance across the axis of the crystals measures $\frac{150}{1000}$ to $\frac{175}{1000}$ of an inch, which, for a good wearing rail, I consider coarse, though the majority of rails in the track are much coarser. Specimen No. 3 is from the same rail, taken near the top of the head, and shows that the mechanical treatment of rolling has broken up the coarse crystallization, rendering it practically amorphous, very fine in texture; in fact, much finer than can be expected in rails until higher carbons are reached than has been until recently considered advisable to put in the tracks. As we increase the carbon in rails we increase the hardness, raise the elastic limit and tensile strength, but, on the other hand, decrease the elongation, and, without great care, render the steel brittle under shock instead of retaining sufficient toughness in the rails to render them safe in the track during winter in this latitude. The element phosphorus tends to render rails brittle or cold-short, and as the carbon is increased the phosphorus must be decreased,

at least with ordinary sections having deep heads and thin bases. Phosphorus exists in the pig iron, or the ores from which the pig iron is made, and to such an extent in many ores that they are unsuitable for Bessemer metal, and it requires some care to select ores which will run from .08 to .10 of 1 per cent. of phosphorus, about the limit to be combined with .35 to .40 of 1 per cent. of carbon. While rails, many years since, containing .35 to .40 in carbon were suitable for the traffic at that time, they wear too rapidly under the present traffic. To increase the carbon for better wearing qualities, it is first necessary to introduce a section for heavy rails which would cool more uniformly, reducing the coarseness of the texture, and at the same time keep the phosphorus down to avoid brittleness.

In 1883 I designed an 80-pound section, which makes the structure of the metal in the head much finer than usual. The section was put into service in 1884, the manufacture of which became the type of modern sections. Over 200,000 tons of this section have been put into service, some of the rails having .50 in carbon. Even with so much carbon the elastic limits of the steel are below what is necessary for modern traffic, and I am now making rails with .60 carbon, the phosphorous being down to or under .06. Specimen No. 4 shows a piece of steel from such a composition which is very fine-grained for a large rail, tough, and has a tensile strength of 120,000 to 130,000 in the head, the elastic limits ranging from 60,000 to 65,000 pounds. Such rails can be produced commercially, the cost only being increased about one-tenth above the cost of ordinary rails.

Without microscopic examination it is difficult to see why it is so important to make the rails of fine texture and high elastic limits. If a rail simply had to perform the functions of a girder, we could increase its dimensions so that it would have ample strength, even though the elastic limits of the metal were low. But the upper surface of the rail must also act as the infinitesimal rack by which the drivers secure their adhesion for locomotion. Tracing these matters out more fully, we find the metal, in the head of the rail under a driver, in *compression* to the vertical axis of the section, while the metal under the neutral axis would be in *extension*, which would reach to each tie, beyond which, as far as affected by the weight of that driver, the base would be in compression at the head in extension. These strains would be reversed as the driver or wheel reached the next tie space. The metal in the head directly under the wheel must not only bear the weight upon the driver, but also all the traction the driver is exerting to draw the train. From the small areas in contact, the ratio of pressure is from 60,000 to 80,000 pounds per square inch, while the traction often amounts to one-half as much for the surfaces in contact as longitudinal strain upon a thin layer of surface metal in the rail head. Examining the rails in the track with the microscope, we find not only small portions of the metal torn out, but a series of minute cracks, showing that the metal has been strained upon the surface beyond its elastic limits, and surface wear of metal rapidly occurs. To check this wear we need high elastic limits of the metal for the surfaces in contact. The metal in the tires of wheels abrades on the surface and also drops out in patches, as may be seen in specimens Nos. 3 and 4.

It will be readily understood that, while it is desirable to have suffi-

ciently high elastic limits in the steel to keep the section from taking permanent set under the loads or trains, it is necessary to have high elastic limits in the metal to resist wear. Steel of .35 to .40 carbon has elastic limits in the head varying from 38,000 to 45,000 pounds per square inch, and even then, in the thin-flanged rails, is liable to be brittle. In steel like that shown in specimen No. 4 the elastic limits range from 60,000 to 65,000 pounds in the head, and it is tough in the sections in which it is used. In the 75-pound section, into which several thousand tons have been rolled, the rails are exceptionally tough, exceeding, so far as any records have been published, any tests which have been made. In the 95-pound rails, into which many thousand tons of high carbon metal have been rolled, they are much tougher than was supposed possible to make such large sections. The tendency of improvement in quality of steel is now the production of a fine texture having high elastic limits and considerable percentage of elongation before the full limit of tensile strength is reached. Specimen No. 5 shows the end of a tensile specimen of 53,470 pounds elastic limit and 23 per cent. of elongation, the fracture fine and silky, showing at once that it was a tough piece of metal. No evidence of coarse crystalization on the interior of the specimen is to be seen, portions of the matrix penetrating and pulling out from the interior of all the crystals. This steel has been worked to make a fine texture. Specimen No. 6 is from the side of specimen No. 5, and shows on the exterior a tendency to separation on the outside surface of the original large crystals as soon as the steel has passed the elastic limits. On the interior, each crystal being surrounded, greater flow or distortion takes place before separation. This specimen will also serve to better illustrate my remarks about the necessity of high elastic limits in surface of the rails to resist wear.

Reference List of Original Articles Relative to Diatoms Published in the American Monthly Microscopical Journal.—Volumes I–XII.

By ROBERT W. SMILEY,

WASHINGTON, D. C.

[Compiled by request of Monsieur J. Tempère, Editor of *Le Diatomiste.*]

Volume I. 1880.

Procuring and Cleaning Diatoms. By K. M. Cunningham. April, p. 66.

About Diatoms. (Editorial.) May, p. 84.

Direction for Cleaning Diatoms. (Editorial.) June, p. 107, and August, p. 146.

About Diatoms. By Chas. Stodder. June, p. 113.

Synopsis of Diatoms. (Editorial.) July, p. 135.

Parasites on Diatoms. (Editorial.) August, p. 151.

About Diatoms. By C. M. Vorce. August, p. 158.

Movement of Diatoms. (Editorial.) October, p. 182.

Synopsis of Diatoms in Belgium. (Editorial.) October, p. 198.

Cleaning Diatoms by Mr. G. C. Morris' Method. By A. L. Woodward. November, p. 215.

VOLUME II. 1881.

Motion of Diatoms. By J. D. Cox. April, p. 66 and November, p. 206.

Movement of Diatoms. (Editorial.) April, p. 75.

An Excellent Method for Cleaning Diatoms. By K. M. Cunningham. May, p. 93.

Cleaning Diatoms. By K. M. Cunningham. June, p. 114.

Terrestrial Diatoms. (Editorial.) September, p. 167.

Fineness of Striation as a Specific Character Diatom. By H. L. Smith. December, p. 221.

Motion of Diatoms. By G. M. Sternberg. December, p. 227.

VOLUME III. 1882.

Motion of Diatoms. By Henry Mills. January, p. 8.

Cleaning Diatoms. By K. M. Cunningham. January, p. 14.

Motion of Diatoms. By C. M. Vorce. March, p. 43.

Desmids and Diatoms. By H. L. Smith. May, p. 84.

Preparation of Diatoms. By R. S. Warren. June, p. 111.

Preparation of Diatoms. By Fred Kitton. August, p. 153.

*New Process of Preparing Diatoms. By W. Brun. December, p. 222.

Cleaning Diatoms. By R. S. Warren. December, p. 225.

Selecting and Arranging Diatoms. By J. Chalon. December, p. 236.

VOLUME IV. 1883.

Notes on Diatomacæ from Tampa Bay, Florida. By Charles Stodder. February, p. 30.

Motion of Diatoms. By J. M. Adams. March, p. 59.

Movement of Diatoms. By Cornelius Onderdonk. April, p. 61.

† Punctations of Diatoms. August, p. 141.

Diatoms in Barbadoes Deposit. By T. Christian. September, p. 179.

Cleaning Diatoms. By J. Y. Bergen, Jr. October, p. 234,

New Slides of Diatoms. By C. L. Peticolas. December, p. 234.

VOLUME V. 1884.

Structure of Diatom-Shell. By J. D. Cox. March, p. 45, April, p. 66, May, p. 85, and June, p. 104.

Structure of Diatoms. (Editorial.) March, p. 53.

Photographs Showing the Structure of Diatom-Shells. (Editorial.) June, p. 112.

VOLUME VI. 1885.

‡ Structure of Diatoms. By G. C. Wallich. March, p. 53.

Diatoms of the Gulf. By J. D. Cox. August, p. 145.

Diatoms and How to Collect Them. Translated from the German by B. Muller. December, p. 230.

Fixing Arranged Diatoms and Sections. (Editorial.) December, p. 233.

Striæ of Diatoms on the Moller Probe-Platte. (Editorial.) December, p. 234.

VOLUME VII. 1886.

New Find of Fossil Diatoms. By K. M. Cunningham. February, p. 39.

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* Translation from *Bulletin de la Soc. Belge de Microscopie.*

† Remarks of M. Grunow with reference to the work of M. Prinz, translated and condensed from the *Bulletin de la Soc. Belge de Microscopie.*

‡ From *English Mechanic.*

Getting Rid of Fleas.—Place sheets of common adhesive fly paper on the floors of infested rooms, with a small piece of fresh meat in the centre of each sheet. The fleas will jump for the meat and adhere to the paper.—*Washington Star*.

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* Extracted from *Botanical Gazette*, Nov., '86.
† Extracted from *English Mechanic*.

The Evolution of the Compound Microscope.

By J. MELVIN LAMB, M. D.
WASHINGTON, D. C.

[Address (omitting some introductory remarks) delivered at the opening of the Medical Department of Howard University. October 1, 1891.]

To some of my audience it may not be unknown that the present year is the three hundredth anniversary of the invention of the compound microscope—the tercentenary of this now, it would seem, well nigh perfected instrument. It was intended to have celebrated this event by an International Exhibition of Microscopes at Antwerp in August and September, this year, but the exhibition has had to be postponed for want of sufficient space. A circular letter has been issued regarding the "Exposition de microscopie général et rétrospective" with program of the undertaking, which gives one some idea of the magnitude of the proposed exhibition. It is intended to make this an event in the history of the microscope, the thorough success of which is assured by the names of the scientific men interested, foremost appearing Abbe, Crisp, Natchet, Hartnack, Zeiss, Dallinger, Cox, Smith, Pelletan, and Van Heurck.

It is proposed to subdivide this exposition into ten large sections, treating, individually, (1) Of microscopes employed in every branch of scientific work, as well as microscopes for special research. (2) All forms, ancient and modern, of apparatus employed for illumination. (3) Apparatus used in conjunction with photo-micrography. (4) Every variety of accessory apparatus, which for the various means employed would prove too lengthy for my mention. (5) Apparatus for mensuration. (6) A complete collection of ancient and modern section-cutting machines (or, technically speaking, microtomes). (7) All kinds of apparatus employed in the technique of microscopical research. (8) Every variety of microscopical work to have representation by permanent preparations. (9) Apparatus for bacteriological investigations, modes of culture, etc., and demonstration of the details of this subject; and lastly, but by no means least in interest, (10) A section of microscopic bibliography, which will, in a measure, prove the record of all that has been achieved in the past three centuries, and which may be observed in the sections previously mentioned. (See J. Roy. Micr. Soc., Lond., 1891, LXXXI, 271.)

At this exhibition the history and development and present perfection in both design and workmanship will be illustrated, covering a period of three hundred years.

Therefore, it is perhaps not inappropriate that I ask your attention for a short time to the history of an instrument which has been of such profound benefit to mankind.

In this hasty review I cannot enter into details concerning the history of this instrument, which served our ancestors as toys and ornaments, and which has developed into the magnificent instrument of to-day, revealing marvels of the unseen world. Should you be so far interested, I would advise you to consult the writings of the various authors upon this subject, when you will observe that almost every step in the improvement of the microscope has been made in the face of the most dis-

couraging predictions of high scientific authority that it was physically impossible. My time this evening and your patience would not allow of more than a hasty glance through its history. For the details, consult the many well-filled books—I might say, libraries. As many as 500 works treating of the microscope and its employment can be found in a single collection in this city.

The history of the microscope prior to the year 1590 is fragmentary. The question of antiquity of magnifying lenses has been thoroughly discussed. A large number of writers have, at various periods, been engaged in the collection and examination of the works of ancient writers. These, in turn, were compared and further elaborate research was conducted as late as 1871 by M. T. H., Martin, who, in his conclusion, remarks that magnifying lenses were not known to the ancients, or, at least, were not used by them for any practical purpose. Mr. John Mayall, of London, deceased but a few weeks since, who had devoted many years of his life to the study of the history of the microscope, also to a collection of ancient and modern instruments, remarks in his excellent series of lectures delivered before the Society of Arts, London, in 1885, that his views agree in the main with those of Mr. Martin. He came to the conclusion that the microscope, as we know it and employ it, is essentially an invention of modern times, and to use his expression, "hit upon at a period corresponding almost marvellously with the advent of the spirit of modern research, when the need of such an instrument was, so to speak, most intensely felt by those precursors of modern science who first struggled out of the meshes of the ancient empirical methods into the free air of experimental methods."

There are numerous instances cited of remote date, that many authors are disposed to accept with historical significance, of the microscope. Mention is made in Aristophanes' comedy, "The Clouds," 431 B. C., of the employment of burning glasses. Pliny mentions that physicians cauterized by means of a globe of crystal. Alexander states that objects may be ignited by heat of the sun passing through "a vase filled with cold water." Similar statements are to be found in the works Philopon. Seneca makes mention that "letters, though small and indistinct, are seen enlarged and more distinct through a globe of glass filled with water."

Many passages could readily be quoted to show that the ancients were awake to the effects of burning glasses, though the underlying principles were not observed.

Many remarkable and ridiculous anecdotes are recorded by the ancient writers concerning these early burning glasses. The burning of the Roman fleet before Syracuse, 250 B. C., by means of polished metal specula, shows that the attention of the ancients was directed to the laws of light, but this and other grave and doubtful questions are compared by the able historian before mentioned, Mr. Mayall, "to that of our own Swift when he introduces us to the professor in the Grand Academy of Lagodo engaged upon a project for extracting sunbeams out of cucumbers, which were to be put in vials hermetically sealed, and let out to warm the air in inclement summers."

Before passing over the early records, which contain so many allusions to glasses of this form, I should direct your attention to a piece of rock crystal, "plano-convex," found by Mr. Layard at the excavations

of Sargon's palace, Nimroud. This lens is oval, about one and one-half inches long, one inch broad, and three-sixteenths of an inch thick. This Assyrian "lens" is now in the collection of the British Museum, and bears date of 721–705 B. C.

Authorities differ in opinion as to the possibility of this being a lens, or more particularly as to its employment as such. Brewster, after critical examination, states that it condenses light, and that it has a focus of about four and one-half inches. The probable date of this lens is fixed by the authorities of the British Museum by the objects found with it.

This Museum contains, also, two antique bosses to which are assigned the period of "not later than 270–260 B. C." But we will pass beyond this early history of optics involved in considerable obscurity, and call your attention to a more authentic period.

The first instrument to which I wish to draw your attention is the first compound microscope, made in Middleburg, Netherlands. It consists only of two convex lenses, and was made by Hans or Zacharias Janssen in 1590. There is a letter written by William Boreel, Dutch Ambassador in France, stating that Hans and Zacharias Janssen, whom he knew perfectly well, having been their neighbor at Middleburg, and having often played with them when they were young, he says in that letter that compound microscopes were made by the Janssens long before the year 1610.

About 1866 an old microscope was found at Middleburg. It was exhibited at the South Kensington Loan Collection in 1876. Harting (an author and historian of the microscope), after examining the original, came to the conclusion that it was really made by Janssen. In 1876, when the original was exhibited at the Loan Exhibition, Mr. Crisp had a copy of it made, and in 1884 Mr. Mayall had a copy made after Mr. Crisp's copy for the collection in the Army Medical Museum in this city.

In 1891, shortly before his death, Mr. Mayall went to Middleburg in person and examined the original, became dissatisfied with the accuracy of the reproduction, and had four reproductions made under his eye; one to replace the copy in the Army Medical Museum.

The original was presented to the "Zeeuwsch Genootschap der Wetenschappen," and from that time was so unknown, even in Holland, that it is not mentioned in such a complete history of the microscope as that of Harting. (Geschichte und gegenwärtiger Zustand des Mikroscopes, Braunschweig, 1866.) The magnifying power obtainable with the instrument is not great.

The Italians have made great efforts to give to their nation the credit of inventing the microscope, but it is now clearly shown and accepted that the Janssens made the first microscope at Middleburg, Holland, about 1590 or 1591.

Galileo, from the testimony of himself, states that the instrument was of Dutch origin, and of date anterior to his own production of the telescope, 1609.

Much interest was shown about the 16th century in the effects produced by varying the position of lenses, and after the first invention there followed a goodly train of makers. Galileo, 1637; Divini, 1657, and Campani, ante 1665; Hooke, 1665; Chérubin d'Orleans, 1671;

Leeuwenhoek, 1673; Bonanni, 1691; Hartsoeker, 1694; Musschenbroek, 1702; Marshall, 1704; Adams, Culpeper, ante 1738; Cuff, 1740, and Dolland, 1790.

To those of you who are not familiar with drawings of the very early forms of microscopes, it will be interesting to observe the various models of instruments, and you will be readily convinced that the opticians of those days had a very imperfect idea of the requirements of the microscope. Descartes "Galilean" microscope, 1637, and one of 1657, figured in Schotts' *Magia Universalis* and Divini's, same date, are very curious forms, and apparently measure from three to four feet long, while the eye-glasses are said to have been as broad as the palms of a man's hand. These measurements are vague, but sufficiently suggestive to convince one that it must have been a formidable instrument.

During this period the progress was very slow, and the different forms appear to be, more or less, a reproduction of the others. Very little original work can be shown, and as Mr. Wilson, in his history of the microscope, observes, this tends to show "that the instrument was seldom sufficiently used to show its weak points, while little improvement seems to have been made in the definition of the instruments."

Fontana, of Naples, claims to have made microscopes in 1618, and even as early as 1592. Hufnagel (George) has published a work on the insects, with copper illustrations, which must have necessitated the use of some high-power lenses.

The next microscope I would mention is a very pretty compound microscope by Giuseppi Campani, and antedates 1665. Campani was an optician of considerable note, and this instrument is dated as preceding Robert Hooke's, 1665, because it has no field lens to the ocular. As Campani would not have neglected so important a feature after its publication, it is safely assumed that his instruments were constructed before 1665.

The body-tube of this instrument is of ivory, screwing into a ring of bone. This is mounted within a silver ring connected with three silver scroll legs coming off from a base of ebony. It is about 12 inches high when extended. The instrument bears the name of Campani, and I would add, in passing, that it is a tradition in the museums of Italy that Campani put his name on all of his microscopes. This form of microscope is considered a beautiful example of an early Italian microscope.

The year 1665 brings us to a specially interesting period in the history of this great instrument.

The publication of Hooke's "Micrographia" and the suggestions contained therein all point to his practical ability in the use of the microscope. He has described and illustrated a very great number of objects as seen through the instrument of his day, and describes, also, his method of constructing high-power lenses.

Some authorities are of the opinion that he was the first to apply the field lens to the eye-piece, but in the notice of Huyghens, in the *Bibliographie Universelle*, it appears that Huyghen's had applied this to his telescopes previous to 1659, and this is prior to Hooke's work about six years.

Hooke was, it is thought, the first to describe a method of estimating the magnifying power of the compound microscope and must be credited with the first suggestion of immersion lenses. He was the

first to give new life to microscopy in England, and made great progress in the improvement of the instrument, both optically and mechanically, and a glance through his "Micrographia" would readily convince one of his knowledge of the use of the instrument and its application to research. Herschel has referred to him (Hooke) as "the great contemporary, and almost the worthy rival of Newton."

On February 6, 1672, Sir Isaac Newton communicated to the Royal Society his "design of a microscope by reflection," consisting of a spherical concave speculum of metal, and an eye-glass which magnified the reflected image of any object placed between them in the focus of the speculum.

Leeuwenhoek, the founder of histology, is prominent in the history of the microscope during the latter part of the 17th century—about 1673. His microscopes were of the rudest construction mechanically, while optically they consisted only of a bi-convex lens let into a socket and a hole drilled into the plate for the eye to look through. To quote Mr. Mayall, "his reputation as a discoverer in microscopy was really based on his patience and dexterity in the preparation of his objects, and on the skill he brought to bear on the interpretation of his observations."

His investigations in histology were very great, as are shown in his "Anatomia Interiora Rerum." Particularly noteworthy are his researches on minute nerve structure and on the capillaries. With such imperfect instruments and no methods of preserving histological objects, we can well marvel at the amount of his work and the accuracy of his observations.

While it is difficult to assign the microscopes of the latter part of the 17th century to chronological order, the period is remarkable for a large number of instruments of various designs, prominent among them being some excellent models of early English microscopes. Two quaint models, binocular, by Chérubin d'Orleans, respectively 1677 and 1685, Grindl's compound microscope, 1687, Bonnani, 1691, and Hartsoeker's simple, 1694, and Gray's "Water Microscope," 1696, consisting of a plate of brass with minute holes in which drops of water were to be placed, but without any arrangement for holding the object. Drops of water were put in the minute apertures, forming a bi-convex lens of unequal curvatures by which, with care, observations could doubtless be made.

The first half of the 18th century records the names of many makers of microscopes, and the period is remarkable for originality. John Marshall's double microscope, 1702. A number of important innovations in microscopical research are embodied in this—a fine adjustment screw; a ball-and-socket joint is employed with the advantage of inclining the entire microscope, and the first appearance of a condensing lens. This instrument is employed with a candle beneath the condenser, from which it is inferred that the mirror used for reflection of rays was at this date still unknown. Musschenbroek had two curious forms dating 1702.

Culpeper make a number of models between the date of 1720–1740, each model being a decided improvement over the previous ones. His microscopes are all figured with the mirror. Scarlet's, Lieberkühn's solar microscope, Martin's Universal, and George Adams's Universal Microscopes all appeared in rapid order prior to 1750, and the improve-

ments, as shown by each one of them at their respective dates, were remarkable. About 1750 appeared Adams's Solar Microscope, for transparent and opaque objects, and these are now considered beautifnl specimens of rare solar microscopes. Adams made a number of forms which are figured in his "Essays on the Microscope," London, 1787.

During the years 1750 to 1800 makers of microscopes were numerous, the most distinguished makers being Cuff, Ellis, Dolland, Martin, Adams, and Dellebarre; the works of these men speaking of difficult investigation, originality, and marked progress.

Cuff's models were much sought in their day and were considered very serviceable working instruments. The fine adjustment was of great delicacy and showed that Cuff spent much labor in the improvement of the mechanical construction.

The period of achromatism as applied to the microscope, about 1820, marks a period in the history of the instrument from which one can readily observe the great advance made in the perfecting of the instrument, both optically and mechanically. Great changes took place in the construction, with particular reference to the means of focusing. This period may be reckoned as the dividing time between the two classes of instruments, namely, the ancient, those made prior to the date of achromatism, and the modern, those constructed subsequently.

In 1824 Tully constructed an achromatic microscope, and he applied mechanical motion to the stage of the instrument.

Amici, Selligue, Chevalier, and Merz seem contemporaneous, and represent microscopes of the achromatic type between 1820 and 1835. In the history of this instrument from this date on to the present year the names of Oherhaeuser, Hartnack, Zeiss, Reichert, Nachet, Powell, and Leland, Grubb, Zentmayer, Tolles, Bulloch, Beck, Ross, and Swift will ever stand out as memorials, and mark distinctive epochs of advancement. During this period inventions of every description, different forms of stands, innumerable accessories, achromatic condensers, mechanical stages, a variety of new lenses, both dry and immersion, adjustable and non-adjustable, and new forms of oculars, have been introduced in a whirl. Many of these proved of little value, some were but the stepping-stones to valuable future improvement, while many will prove of everlasting benefit and service. To repeat Mr Wilson: "It would be quite impossible to pass in review the many excellent types of microscopes designed since the introduction of achromatism, and the progressive stages by which our grand instruments have been undergoing a gradual process of evolution from the primitive ones. Suffice it to say, that the advance in the construction of the instrument has been steady and continuous from the earliest known simple model by Tulley, with its struts connecting the base with the body-tube as a support, to the handsome and perfect instruments of the present day, embracing every possible adjustment that is known to make it suitable for all purposes of investigation."

It may be of interest to you to know that, contained in the Army Medical Museum, in this city, there is a collection of ancient and modern microscopes, numbering at present about 175 instruments of all forms, where you may observe the progressive stages by which the instrument has grown to its present state of perfection.

Mr. Frank Crisp, of London, has one of the largest and most complete collections of this character.

During the last fifteen years great progress has been made in the improvement of the objectives or object glasses. The English, Germans, and Americans have been in active competition, and each year has witnessed some great advance by one or the other in the perfecting of objectives. Ten years ago the President of the American Society of Microscopists in his annual address remarked, "that lenses which were believed to have so nearly reached the limit of perfection fifteen years ago are antiquated now, and the theoretical limit of perfection has moved forward like the horizon, and is as far off as ever." Compare the state of the microscope of 1882 with 1891, and note the change that has been realized. In 1869, in a letter addressed to Col. Woodward, U. S. A., Nobert expressed his belief that it was physically impossible to resolve with a 1–16 lens more that 91,000 lines to the inch. But a short time after Col. Woodward had succeeded with a Powell & Leland lens, 1–16, in resolving 112,000 lines to the inch—21,000 lines more. The highest record of resolution that has been attained is that of Mr. Fassoldt, who has ruled and demonstrated 120,000 to the inch. This may be considered the present limit of visibility. The theoretical limit of 1869 was passed.

Water immersion lenses proved a gain over the former dry lenses. Later, the latter gave way to the homogeneous immersion lenses. But a few years since, 1886, the labors of Professor Abbe brought forth a new kind of optical glass, the invention of which gave new life to microscopy. These special lenses, called apochromatic, are remarkable for their freedom from spherical aberration, practically colorless, giving an image clearer and of better definition than could be gained by the achromatic lens. Of special advantage are the new glasses in photomicrography—the faithful recorder of all microscopic observations.

In this brief description of the history of this wonderful instrument mention has been made of but a few facts concerned in its development. If you will look into some of the old works of the 16th and 17th centuries, where much of the interesting history of the microscope is written, you will be curious to observe how, from the exciting curiosity it was in its infancy, it grew to the valuable, remarkable, and perfect instrument of research it is to-day.

Look deeper and see the investigations and discoveries that have followed its birth. Fields of investigation unheard of were opened up. What of the branches of science, histology, biology, embryology, bacteriology? What have we learned from this instrument, which a few hundred years ago was a toy, delighting and bewildering alike the makers and the curious employers?

Mr. Wilson remarks: "What the future development of the microscope may be it is impossible to say. Fifty years ago no one would have dreamt of the great advances which have been made up to the present time, and only a few years ago the limit to the further improvement seemed to have been reached when the introduction of the new kind of glass gave a fresh impetus to microscopy."

"There remains, of course," says Professor Abbe, "the consolation that there is much between heaven and earth that is not dreamt of in our philosophy.

"Perhaps in the future, however, genius may succeed in making forces and processes serviceable, which may enable the boundaries to be overstepped which now seem impassable. I believe, however, that those instruments which may, perhaps, in the future more effectually aid our senses in the investigation of the material world than the microscope of the present will have little else than the name in common with it."

To look at the microscope in its early days, three hundred, two hundred, yes, but twenty-five years ago, and review the progress made in the optical and mechanical construction, of the investigations that have been instituted, and the results achieved by the aid of this wonderful instrument, you can but predict that the microscope has before it the prospect, if not the assurance, of a most glorious future.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

Pathology of Gout.—Dr. G. Linden, of Kassel, records in *Deutsche Medicinal Zeitung* some microscopical observations upon gouty deposits. The abnormal and pain-producing growths under the nails are caused by the irritating influence of crystals of urate of sodium deposited in the cellular tissue. He was his own patient. Scraping out the loose cellular tissue from under the nails, and examining it microscopically after diluting it with water or vinegar into a pulpy mass, "it presented in the midst of numberless epidermal cellules of strong refractive power many needle-shaped crystals of urate of sodium, partly crowded together in little bunches."

Megastoma Entericum as a Cause of Catarrh of the Stomach.—Dr. Mortz reports a case of chronic catarrh of the stomach where he found enormous quantities of *Megastoma entericum*, a species of infusoria, first described by Grassi. The Megastoma, belonging to the order of Flagellata, has a pyriform body, its anterior end being provided with a suctorial organ, at the bottom of which two nuclei are situated. Around the suctorial organ (peristoma) six flagella are seen, serving as organs of locomotion, while two other flagella are attached to the caudal end of the body. Besides these free forms, the Megastoma appears also in encysted, permanent forms, which are oval in shape.

The animalcule lives in the small intestine, preferently in the upper portion, where it attaches itself to the mucous membrane by means of the suction apparatus. In the stools the encysted forms are most frequent, and only in the more violent diarrhœas free animals also make their appearance in larger quantities. It is sometimes found in patients who present no diarrhœal symptoms. Its expulsion, after it has become settled, is difficult. Quinine, hydrochloric acid, naphthaline, glycerine, and extract of male fern were used without result.

Ringworm of the Scalp.—The *N. Y. Med. Jour.* for October 10, 1891, contains the record of thirty-one cases of this obstinate disease treated by the germicidal method. The article is by Charles G. Kerley, M.D. As is well known, the disease is due to the presence

of a parasitic fungus, a *Trichophyton*. The treatment employed which seemed most successful was to cut the hair close, and once daily to rub into the scalp a solution of bichloride of mercury in kerosene. Two grains of bichloride were dissolved in a small quantity of alcohol, and this was added to half an ounce each of kerosene and olive oil. Then a dressing of simple ointment was used for a few days, and the bichloride treatment renewed at longer intervals. In some cases a saturated solution of iodine in alcohol was used alternately with the bichloride applications. The average time required to cure by this method was six weeks and a half.

Pathology of Angina Pectoris.—In the American *Lancet* for August, 1891, Dr. Geo. Duffield gives a careful report of a case of angina pectoris, with post mortem and microscopical examination of the heart. The principal lesions were endarteritis and calcareous degeneration of the coronary arteries. We recall a case in which the patient succumbed to the first attack of this disease, and the coronary arteries were found almost completely occluded by calcareous deposit. The muscular tissue of the heart tore as easily as wrapping-paper.

Microbes in the Water of the Dead Sea.—It has always been asserted that the water of the Dead Sea was free from microbes, and we had contemplated advising some of our American cities to lay mains to it and thereby secure better water. But the *Lyon Médicale* records researches made by Prof. Lortet, showing that the water contains bacilli and that the ooze on the bottom abounds with the microbe of tetanus.

NOTES.

Photo-Micrograph Received.—We desire to return thanks to the donor for the following interesting photo-micrograph:

P. Pubis—photographed by Dr. L. Deck, Salamanca, N. Y.

Vivisection.—Dr. Gaertner advocates the authorization by Congress of the appointment of a board of examiners, upon whose certificate scientists, microscopists, pathologists, and histologists may be authorized to practice vivisection, and thinks that in the interest of humanity no other persons should be permitted to act.

Tuberculosis.—Arthaud places the period of incubation at two months. The disease may be taken by anyone who is predisposed thereto who works with consumptives in poorly-ventilated rooms or shops, or even by riding in tightly-closed railway cars with sufferers.

John Mayall, Jr.—The late Secretary of the Royal Microscopical Society died recently, leaving his family in straightened circumstances. An effort will be made in London to raise a Mayall fund for the benefit of his wife and children.

Harold C. Ernst was formerly Harvard's crack base-ball pitcher. Now he has dropped back to professor of bacteriology.—*Washington Post.*

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL., WM. E. LOY, *Sec'y.*

At a meeting of the Microscopical Society held Oct. 7, 1891, at the rooms at 432 Montgomery street, Kaspar Pischl, M. D., read a short paper and exhibited a slide of *Gonococci* from a case of *Ophthalmia neonatorum*. Much of the paper was of a technical character, but the doctor mentioned that of the totally blind in Europe statistics proved that fully one-third was caused by *Ophthalmia neonatorum*. The remedy is so simple and so efficacious, when treated in its early stages, that in most European countries laws have been passed making it compulsory on nurses to report any inflammation of the eye in infants to the designated authorities within six hours. He said a 2 per cent. solution of nitrate of silver would cure 90 per cent. of the infants thus afflicted. Thus far no concerted movement has been made in this direction in any State except New York, where a law has been passed similar in its provisions to laws in various European countries. Dr. Pischl thought it would be a great boon to the people of California to have a similar law enacted, and he hoped to see united action on the part of the medical profession.

F. O. Jacobs of Columbus, Ohio, was present as a visitor, and favored the Society with a description and drawing of a freezing microtome which he had designed and constructed. In the different forms of freezing microtome employed, great difficulty is experienced in keeping the mass in a congealed state, unless one operates in an atmosphere at a low temperature; while the one designed by Mr. Jacobs works very satisfactorily in the temperature of an ordinary room or laboratory.

Dr. Mouser showed some agar he had prepared of such transparency that cultures could be perfectly photographed *in situ*. The tube shown had a fine colony of *anthrax bacillus*.

Henry C. Hyde exhibited a new illuminator, Simons', which was easily and quickly adjusted to the various requirements of microscopic illumination.

The meeting October 21, 1891, was an informal or conversational one, but President Wickson formally called the meeting to order for a few moments that an election of new members might be held. M. E. Jaffa and Henry E. Sanderson, M. D., both residents of this city, were elected regular members.

After the transaction of the business as above stated, the meeting resolved itself into an exhibition, with brief verbal communications pertaining to the objects exhibited.

Dr. Douglass W. Montgomery recalled the case of *Acromegalia*, which resulted in the death of the Italian peanut vender at the Almshouse about two months ago. He exhibited a series of slides, with different stains, showing *corpora amylacea* or amylaceous bodies found in the prostate gland. The doctor briefly described the development of the disease and illustrated the structure of the amylaceous bodies, which in the slide exhibited were stained with *hæmatoxylin*. His remarks called forth considerable discussion, and questions and answers followed, showing that his hearers were deeply interested.

Dr. C. E. Cooper exhibited a slide prepared from the sputum of a patient who had received twenty-five treatments of Koch's *tubercu-*

linum, in which the *bacilli*, instead of presenting the usual rod-like appearance, were broken up into little dots or nodules.

Ed. M. Ehrhorn exhibited some very interesting objects, chiefly scale insects, their enemies and parasites. He showed the voracious cottony cushion scale, *Iceryia purchasi*, from eggs to imago, together with its natural enemy, *Vedalia cardinalis*, or Australian lady-bug. He also exhibited other noxious insects, as the red scale, the San José scale, and their parasites.

Henry C. Hyde exhibited and explained the various methods of measuring miscroscopic objects, and for the purpose had a stage micrometer, Jackson's micrometer eye-piece, and the *camera lucida*. A. H. Breckenfeld exhibited a splendid specimen of *Hydra vulgaris*, with dark-field illumination, and called attention to the poison glands, by the aid of which its prey is rendered powerless. L. M. King exhibited a drop of water, with a remarkably fine gathering of *paramecium*.

Charles C. Reidy had under a one-twentieth immersion lens the diatom *Coscinodiscus asteromphalos*, showing the secondary markings beautifully. He had also a photograph of the same diatom, recently made by Nelson, of London, which had called forth considerable comment at a recent meeting of the Royal Microscopical Society in London. The image shown to-night was considered fully equal to the photograph. S. E. Taylor had a very fine frustule of *Surirella gemma*, shown with a one-twelfth objective, immersion contact. Altogether the meeting proved an unusually pleasant and instructive one.

ESSEX COUNTY, N. J., C. M. MARVIN, *Sec'y*.

September 24, 1891.—Annual meeting. The following officers were elected for the ensuing year: President, Frank Vanderpoel; Vice-President, Albert Mann, Jr.; Treasurer, F. B. Carter, and Secretary, C. M. Marvin.

WASHINGTON, D. C.

At the regular meeting of the Washington Microscopical Society on November 17, President Melvin S. Lamb in the chair, it was voted to purchase a Bausch and Lomb stand, with two eye-pieces, 1-6, 2-3, and 2-inch objectives, double nose-piece, and polariscope. The stand is known as the "Continental." The condenser already owned by the Society will be fitted to this stand. The Society also owns a 1-12 homogeneous immersion objective.

NOTICES OF BOOKS.

The Microscope and Histology, for the use of laboratory students in the anatomical department of Cornell University, by Simon Henry Gage, Associate Professor of Physiology. Third edition; entirely re-written. Part I. The Microscope and Microscopical Methods. Illustrated. Ithaca, N. Y., 1891. Andrus & Church. Paper, $1.00; half-leather, $1.25.

There is no nonsense about this book. From the title page to the carefully-prepared index and bibliographical list, it exhibits the thoroughness that always characterizes Professor Gage's work.

In the case of more pretentious works it often occurs that by the

time the treatise is in the hands of the student its technique is antiquated. This fault cannot be attributed to the book before us. It is up to date, and the sections devoted to homogeneous immersion objectives, the sub-stage illuminator, the camera lucida, the micro-spectroscope, and the micro-polariscope will be especially welcome to workers. The suggestions are sententious, but helpful. The typographical work is well done, and altogether it is one of those books that the student and worker in microscopy cannot afford to be without. We submit that a book which is likely to be in such constant use should never be purchased in paper covers. F. B.

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